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Some Epidemiological Patterns in Bovine Mastitis*

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SUMMARY.—The article is based on bacteriological examination of milk samples taken from all the clinical cases of bovine mastitis submitted from one veterinary practice serving a population of approximately 4,000 heifers and cows. Only pretreatment samples from individual animals were included in the survey which continued from 1949 to 1953.

The results have been analysed in terms of the overall incidence of mastitis, and the different bacterial species contributing to the total number of infections for each of the 5 years.

The incidences of infection have been considered in relation to the season of the year, the ages of the infected animals and the stage of their lactations. The overall incidence of mastitis was 13·9 per cent.

The different bacterial infections showed certain trends over the 5 years. Streptococcus agalactiae *infections were the most frequent in each year, but there was a definite decrease in their numbers over the period.* Staphlococcus aureus *infections showed an increase towards the end of the survey.* Str. dysgalactiae *and* Corynebacterium pyogenes *infections fluctuated from year to year according to the prevalence of summer mastitis.* Str. uberis *infections maintained a steady incidence throughout the period.*

Mastitis in general conformed to a definite seasonal pattern, with a high winter incidence, a low incidence in spring and early summer and in certain years pronounced peaks of mastitis in late summer and early autumn. The contribution each category of infection made to this pattern was characteristic for each bacterial species.

Mastitis showed an increasing incidence with age, but this was more marked with some bacterial infections than others. After the age of 6 years the incidence of all infections declined.

Most cases of mastitis occurred in cows in early lactation and in animals whose mammary glands were involuting or quiescent, but some bacterial species infected the udder more frequently at some stages than at others.

ALTHOUGH the interplay of a number of factors in the causation of bovine mastitis is increasingly accepted by those studying the disease, nevertheless it is still true that the disease is primarily a bacteriological problem. This being so, regular bacteriological surveys are an indispensable method of obtaining up-to-date information on the status of this disease in dairy cattle.

By 1948 the more accurate knowledge of the epidemiology of *Str. agalactiae* infections (Imperial Bureau of Animal Health, 1944), and the advent of penicillin were factors likely to influence the extent and the character of mastitis, and it was felt that a bacteriological survey over a number of years would yield information of value.

There are certain difficulties inherent in undertaking surveys of the incidence of mastitis, dependent on whether the survey is based on herd sampling or the examination of individual cow samples. Herd surveys tend to over-emphasise the possible losses because it does not follow necessarily that all bacteriologically positive cows will suffer economic damage from the organisms isolated at the test sampling. Alternatively, the bacteriological examination of secretion from clinical cases of mastitis may give a distorted picture if it is limited to so-called " mastitis problem " herds, or the choice of samples is left to the clinician.

Some of the trends in incidence of the different mastitis infections which this 1949–53 survey brought to light have since become well recognised as part of the present day mastitis picture. Other aspects with particular reference to season, age of the cows, stage of lactation and mixed infections are outlined in this article.

* The data on which this work is based was collected by the author when he was on the staff of the Veterinary Science Division, Research Department of Boots Pure Drug Co. Ltd., Thurgarton, Notts. The complete data will be found in a Ph.D. thesis deposited in the library of the University of Nottingham in 1959.

The Scope of the Survey

It was decided to base this survey on the bacteriological examination of *all* the clinical cases of mastitis attended by the veterinary surgeons in one practice over a number of years, and to exclude from the survey samples taken on a herd basis, post-treatment samples and prophylactic samples taken to determine the bacteriological status of cows which showed no symptoms of udder disturbance.

The co-operating practice was that of Mr. E. Wilkinson, M.R.C.V.S., of Derby, and over the relevant years it was staffed by the principal and 3 assistant veterinary surgeons. The practice is in an area of mixed farming, with a predominance of dairying, and many herds were of the " flying herd " type.

Cow Population

In 1951 the cow population was determined in all the herds belonging to farmers who were clients of the practice. There was a total of 4,267 cows in 154 herds, an average of 27·7 cows per herd. The smallest herd contained 3 animals and the biggest herd comprised 107 milking animals. There were only 9 herds with more than 50 cows each.

In the 3 years 1950–52 the same 10 herds were enumerated each year with the following results :

1950	1951	1952
475 cows	519 cows	527 cows

In 1951 the 519 animals were 12 per cent. of the known total, 4,267 cows, in the practice. Assuming that these same 10 herds still comprised 12 per cent. of the total population in the years 1950 and 1952 when there was no total census, it was calculated that the total cows in those 2 years would have been 3,942 and 4,374 respectively. From these figures it was deduced that the survey was carried out on a total population of approximately 4,000 cows at risk.

Distribution of the Cows within Age Groups

The age distributions of cows in these 10 herds in 1951 were as follows :

DISTRIBUTION OF COWS ACCORDING TO AGE IN 10 HERDS IN 1951

	Age group in years						
	2—3	3—4	4—5	5—6	6—7	Over 7	Total
No. of cows	128	112	88	78	62	51	519
Percentage of total cows	25	22	17	13	12	10	99

These figures bore a reasonable similarity to national figures published by the Milk Marketing Board for 1946–47 (the only ones available at the time) in England and Wales and Derbyshire, and it was felt justifiable to apply the above percentage distributions to the total cow population of the practice, with the following results :

ESTIMATED NUMBERS OF COWS IN EACH AGE GROUP IN THE PRACTICE IN 1951

Age groups in years					
2—3	3—4	4—5	5—6	6—7	Over 7
1,068	946	734	553	534	426

Technical Methods

One sample bottle was used for each cow, secretion was withdrawn from any quarter showing abnormality so that the contents of a bottle might contain material from 1 to 4 quarters depending on the number with mastitis.

Sterile McCartney bottles (20 ml. capacity) supplied by the laboratory were used for the collection of all samples. Generally speaking they were despatched to the laboratory on the evening of the day they were collected and received next morning. Samples received at the week-end were placed in a refrigerator until they were cultured.

Accompanying each sample were brief notes, which included the name of the owner and/or the farm, the identity of the cow, her breed, her age and stage of lactation, and a brief clinical history and description of symptoms.

Examination of Samples

On receipt at the laboratory the sample was shaken and a film made for microscopic examination by Breed's method and stained with Newman's stain. This was examined to determine the degree of cellular response and, if present in sufficient numbers, the type of bacteria in the sample.

Cultural Methods

Using Pasteur pipettes calibrated to drop 30 drops of milk to 1 ml., 3 drops of shaken secretion were inoculated on to the surface of petri plates containing ox blood aesculin agar and crystal violet aesculin thallium acetate blood agar (C.V.T.A.). One loopful of shaken secretion was also stroked out in such a manner as to give individual colonies, on the surface of another C.V.T.A. plate. These were known as the direct plates. The McCartney bottle containing the sample was then placed in the incubator at 37° C. overnight, when it was again shaken and plated out with a loop on the surface of a C.V.T.A. plate. This was known as the enriched sample plate. All plates were incubated for 48 hours at 37° C. and read after 24 and 48 hours. Each sample therefore was plated directly on to one blood agar plate, two C.V.T.A. plates and after incubation on to another C.V.T.A. plate.

Representative colonies were picked and investigated further by appropriate methods. The criteria accepted for the identification of particular species of bacteria are defined below.

Str. agalactiae. Blue tinged colonies on C.V.T.A. with β or γ haemolysis on blood agar. No splitting of aesculin (no blackening or browning of colonies on C.V.T.A.). Hydrolysis of sodium hippurate and no fermentation of inulin, mannite or raffinose. Positive precipitin test with Lancefield's Group B antiserum.

Str. dysgalactiae. α haemolytic colonies on blood agar and some greening of medium on C.V.T.A. No splitting of aesculin, no hydrolysis of sodium hippurate and no fermentation of inulin, raffinose or mannite. Positive precipitin test with Lancefield's Group C antiserum (or Minett's Group II antiserum).

Str. uberis. Colonies causing browning of the C.V.T.A. medium due to the splitting of aesculin. Fermentation of inulin and mannite but not raffinose and hydrolysis of sodium hippurate. Occasionally gave positive precipitin tests with Lancefield's Group D or E antisera.

Staph. pyogenes. Colonies showing varying degrees of pigmentation and wide zones of β haemolysis on blood agar. Inhibited or no growth on C.V.T.A. Positive slide coagulase tests with rabbit plasma.

C. pyogenes. Very small colonies on blood agar, showing β haemolysis after 48 hours incubation. No growth on C.V.T.A. Digestion of litmus milk, fermentation of serum lactose, and liquefaction of solid serum slopes.

Other organisms were identified by morphology, colonial characters on appropriate media and biochemical activities.

All streptococcal grouping sera were obtained from the

Veterinary Laboratory of the Ministry of Agriculture at Weybridge.

It remains to define the interpretations of the results which determined in which particular category each sample was placed.

General Definition of the Type of Infection

The predominating colonies on the direct plates were regarded as those of the causal micro-organism. If the direct plates were negative there had to be a growth of colonies on the enriched plate overshadowing any others before it was accepted as causal. When the cultures on the direct and enriched plates were different, the predominant culture on the direct plate was accepted. However, when there were known mastitis species on the enriched but not on the direct plates, they were accepted as causal.

Definition of "Other Organisms"

This category covers bacteria other than those widely recognised as associated with mastitis. Samples were placed in this category when the predominating colonies were those of coliform bacteria, diphtheroid bacteria (other than *C. pyogenes*), streptococci, other than *Str. agalactiae*, *Str. dysgalactiae* and *Str. uberis*, non-haemolytic and coagulase negative micrococci and yeasts.

Definition of "Negative" Samples

A sample was regarded as negative when there was no growth on either the direct or enriched plates or when there was only a scanty growth of contaminating colonies.

Definition of Contaminated Samples

A sample was regarded as contaminated if it produced extensive growth of moulds, aerobic actinomyces, aerobic spore bearing bacilli, or spreading growth of *Proteus* spp.

Repeated and Post-treatment Samples

It was a cardinal feature of this survey that it should not include post-treatment samples. However, on occasion a sample from the same cow would be re-submitted and some ruling as to how it was to be considered was necessary. So a sample was regarded as a post-treatment sample if it was submitted within 1 month of the previous sample from the same cow, unless it was found that the predominating micro-organism in the second sample was different from that isolated in the first sample, when it was regarded as a fresh infection and included in the results.

Samples received from the same cow after an interval of one month were considered as fresh infections.

It is accepted that many of those definitions, being arbitrary, are open to question, but whatever the criteria adopted in a survey of this nature they can be criticised. It was felt that the only way out of these inherent difficulties was to adopt fairly rigid definitions, despite these drawbacks, and to adhere to them throughout the observations.

States of Lactation

There does not appear to be any universally accepted method of dividing lactation into set periods and the following definitions have been used in this survey :

Calving—from 48 hours before parturition to 1 week after the event.

Early—from 1 week until 7 weeks after calving.

Mid—from 7 weeks after calving until evidence of drying off.

Drying off—milk production failing but secretion still present.

Dry—mammary gland not functioning.

Duration of Survey

Although the survey started in 1948, the collection of figures and information on a defined basis commenced in 1949 and continued until 1953. Data for age and stage of lactation were available for the years 1950–3.

Results

The Incidence of the Different Types of Mastitis

1. *All infections incidence.* The total number of samples examined in the 5 years was 2,684. The figures for all types of infections for the years 1949–53 and their monthly distributions will be found in Table I. The table shows a decline in the total numbers from 625 in 1949 to 308 in 1953.

In 1951 the total figure of 578 cases was 13·5 per cent. of the known population of 4,267 cows in the practice. The percentage incidence for 1950 was 16·6, and 11·8 in 1952. (The total populations for 1950 and 1952 were calculated by extrapolation from the known total for 1951—see Cow Population). The total population of the practice for the 3 years 1950–52 was 12,583 cows and the total mastitis cases was 1,751 which is an incidence of 13·9 per cent. for the 3 years. It was concluded that the incidence of mastitis cases in this practice, which farmers decided needed veterinary attention, was about 14 per cent.

The occurrence of the different mastitis infections throughout the period of the survey are presented by years in Table II, and their incidence per cent. are depicted in Figure 1.

2. *Str. agalactiae incidence.* This organism was the most prevalent in the series (25·6 per cent.) and although its incidence declined from 28·8 per cent. in 1949 to 20·4 per cent. in 1953, it was still the most common infection in the 5th year.

3. *Str. dysgalactiae incidence.* The incidence of *Str. dysgalactiae* varied from year to year. Its highest incidence (15·8 per cent.) was in 1952, its lowest in 1953 (9·0 per cent.) with an overall incidence of 11·25 per cent. for the 5 years.

4. *Str. uberis incidence. Str. uberis* which comprised 18·0 per cent. of all infections was second to *Str. agalactiae* in numerical importance and it showed little fluctuation from year to year.

5. *Staph. aureus incidence.* Staphylococcal infections were 12·5 per cent. of all infections for the 5 years, with little yearly variation until 1953 when it increased to 16·5 per cent.

TABLE I
ALL ORGANISMS BY MONTHS FOR THE YEARS 1949–53

	1949	1950	1951	1952	1953	Totals
January	51 (8·16)	66 (10·0)	62 (10·7)	68 (13·1)	46 (14·9)	293 (11·0)
February	70 (11·2)	81 (12·2)	57 (9·8)	45 (8·6)	23 (7·4)	276 (10·0)
March	43 (6·8)	74 (11·3)	59 (10·2)	65 (12·5)	25 (8·1)	266 (10·0)
April	31 (4·9)	44 (6·7)	49 (8·4)	42 (8·0)	18 (5·8)	184 (7·0)
May	25 (4·0)	42 (6·4)	25 (4·3)	26 (5·0)	14 (4·5)	132 (5·0)
June	35 (5·6)	34 (5·2)	19 (3·2)	16 (3·0)	29 (9·4)	133 (5·0)
July	68 (10·8)	35 (5·3)	29 (5·0)	58 (11·1)	27 (8·7)	217 (8·0)
August	89 (14·2)	38 (5·8)	73 (12·6)	49 (9·4)	37 (12·0)	286 (10·5)
September ...	59 (9·4)	51 (7·8)	47 (8·1)	35 (6·7)	21 (6·7)	213 (8·0)
October	48 (7·6)	52 (7·9)	38 (6·5)	33 (6·3)	18 (5·8)	189 (7·0)
November	59 (9·4)	69 (10·5)	47 (8·1)	25 (4·8)	25 (8·1)	225 (8·0)
December	47 (7·5)	68 (10·4)	73 (12·6)	57 (11·0)	25 (8·1)	270 (10·0)
	625	654	578	519	308	2,684

The figures in brackets are percentages.

TABLE II
THE OCCURRENCE OF THE DIFFERENT MASTITIS INFECTIONS IN THE YEARS 1949–53

	1949	1950	1951	1952	1953	Totals
Str. agalactiae ...	180 (28·8)	207 (31·6)	126 (21·7)	113 (21·7)	63 (20·4)	689 (25·6)
Str. dysgalactiae ...	65 (10·4)	62 (9·4)	65 (11·8)	82 (15·8)	28 (9·0)	302 (11·25)
Str. uberis ...	116 (18·5)	106 (16·2)	115 (19·8)	91 (17·5)	56 (18·2)	484 (18·0)
Staph. aureus ...	68 (10·8)	76 (11·6)	81 (14·0)	61 (11·75)	51 (16·5)	337 (12·5)
C. pyogenes ...	47 (7·5)	32 (4·9)	54 (9·3)	61 (11·75)	17 (5·5)	211 (7·8)
Other infections ...	79 (12·6)	108 (16·5)	72 (12·4)	54 (10·4)	47 (15·2)	360 (13·4)
Negative samples ...	49 (7·8)	42 (6·4)	26 (4·5)	19 (3·6)	10 (3·2)	146 (5·4)
Contaminated samples	21 (3·3)	21 (3·2)	39 (6·7)	38 (7·3)	36 (11·7)	155 (5·7)
Totals ...	625	654	578	519	308	2,685

(The figures in brackets are the per cent. values of the total samples examined).

6. *C. pyogenes incidence.* *C. pyogenes* occurred in 7·8 per cent. of samples over the 5 years but it showed marked annual variations from 4·9 per cent. in 1950 to 11·75 per cent. in 1952.

7. *Other infections incidence.* This group was 13·4 per cent. of all infections and showed some degree of annual variation. Owing to its mixed nature it should not be considered as a homogeneous group. The individual species included in it were not numerous enough to justify separate consideration.

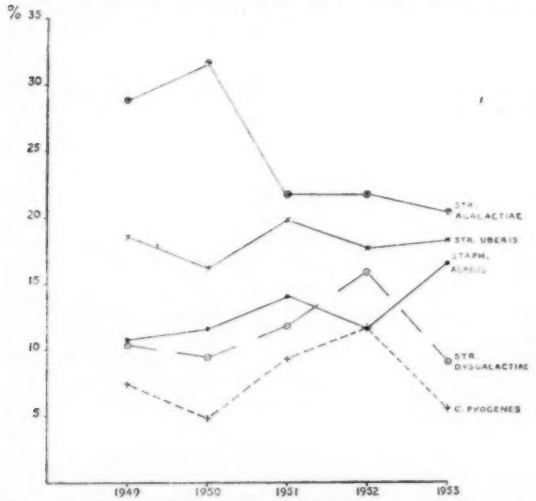

FIG. 1.—A comparison of the incidences of the principal infections, 1949-53.

8. *Negative samples incidence.* Negative samples were not infrequent amounting to 5·4 per cent. of the total, but they declined in frequency from 7·8 per cent. at the beginning of the survey to 3·2 per cent. in 1953.

9. *Contaminated samples incidence.* Samples so contaminated that their cultures could not be assessed comprised 5·7 per cent. of the total samples. Their frequency increased from 3·3 per cent. in 1949 to 11·7 per cent. in 1959.

Seasonal Distribution of Mastitis Infections

The monthly distributions of all categories of infection have been consolidated for the 5 years 1949–53 and they are presented in the last column of Table I and Fig. 2. From this data an overall pattern may be seen.

1. There was a high incidence of mastitis in the months of January, February and March, and usually a high incidence in November and December. In fact nearly 50 per cent. of cases occurred between November and March.

2. There was always a marked fall in incidence in the spring and early summer, April–June. In some years this commenced in April (1949 and 1950) and

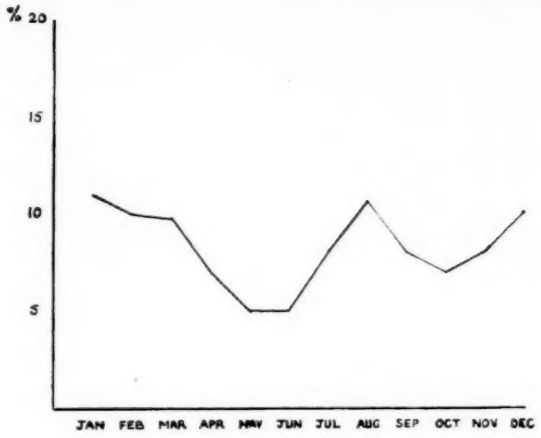

FIG. 2.—The percentage monthly distribution of mastitis infections, 1949-53.

in others not until May (1951 and 1952). In all years except 1953 this trough extended into June. The number of samples examined between April and June represented 17 per cent. of the total.

3. In some years there was a pronounced peak of mastitis incidence in the late summer and early autumn, July–October. Thus there were peaks in 1949, 1951 and 1952 and a slight peak in 1953, but there was none in 1950. In the 5 years under consideration the months July–October provided 33·5 per cent. of the samples received.

This may be summarised by saying that the yearly pattern was a winter peak, an early summer trough and in certain years a late summer peak.

The consolidated monthly distribution of the different infections for the years 1949–53 are shown in Table III and Fig. 3.

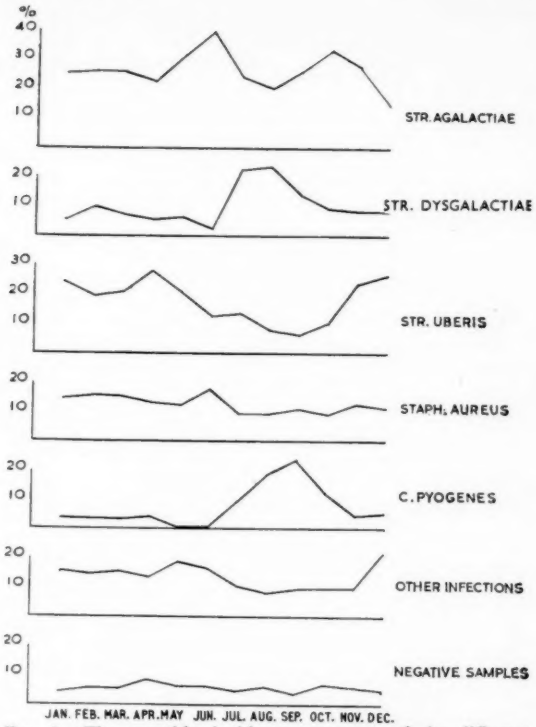

FIG. 3.—The monthly incidence per cent. of the different mastitis infections in the years 1949-53.

Str. agalactiae infections did not show any pronounced seasonal pattern apart from the percentage peak in early summer (40 per cent. in June) and this was a reflection of the fact that the numbers of these infections at that time of year did not decline to the same degree as the total incidence.

Str. dysgalactiae infections predominated in the latter half of the summer, although an analysis year

TABLE III
THE CONSOLIDATED MONTHLY DISTRIBUTIONS OF THE DIFFERENT INFECTIONS FOR 1949–53

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Total samples	293	276	266	184	132	135	224	277	218	189	225	270
Str. agalactiae	74(25·2)	73(26·4)	69(25·9)	42(22·8)	42(31·8)	53(39·8)	58(24·4)	56(20·2)	56(26·2)	63(33·3)	63(28·0)	40(14·8)
Str. dysgalactiae	16(5·4)	27(9·7)	19(7·1)	10(5·4)	8(6·6)	3(2·25)	48(22·1)	78(23·7)	31(14·5)	18(9·5)	20(8·8)	24(8·8)
Str. uberis	71(24·2)	53(19·2)	55(20·6)	51(27·7)	27(20·4)	17(12·7)	30(13·8)	23(8·0)	14(6·5)	19(10·0)	53(23·5)	71(26·3)
Staph. aureus	43(14·6)	43(15·5)	40(15·0)	24(13·0)	16(12·1)	23(17·3)	21(9·6)	28(9·4)	23(10·8)	18(9·5)	28(12·4)	30(11·1)
C. pyogenes	11(3·7)	10(3·6)	9(3·4)	8(4·3)	1(0·7)	1(0·7)	20(9·2)	53(18·5)	50(23·4)	23(12·1)	11(4·8)	14(5·2)
Other infections	46(15·3)	40(14·5)	42(15·4)	25(13·5)	24(18·2)	22(16·5)	22(10·1)	23(8·0)	20(9·4)	18(9·5)	21(9·3)	57(21·1)
Negative samples	13(4·4)	16(5·8)	14(5·2)	15(8·1)	8(6·0)	10(4·6)	17(5·9)	8(3·7)	13(6·8)	13(5·7)	13(5·7)	11(4·0)
Contaminated samples	19(6·4)	14(5·4)	18(7·0)	9(4·8)	6(4·5)	6(4·5)	8(3·6)	8(2·8)	11(5·6)	17(9·0)	16(7·1)	23(8·5

(The figures in brackets are the percentages of the monthly totals)

by year showed that this was more marked in some years than others, particularly so in 1949 and 1952.

Str. uberis infections occurred most frequently in the winter months, and by the second half of the summer were 10 per cent. or under of the total infections. There was some variation in this pattern from year to year, but broadly speaking the percentage distribution was U shaped, the arms of which were a reflection of the winter incidence of these infections.

Staph. aureus infections. The incidence of these infections appeared to have no seasonal character.

C. pyogenes infections had a characteristic pattern with a marked predominance of infections in the months of July, August and September. This was particularly marked in 1949, 1951 and 1952. There was almost a complete absence of infections in the months of May and June (only 2 cases in 5 years).

Other infections : in certain years, 1950 and 1951, these miscellaneous infections were prevalent in the winter months. However, the heterogeneous nature of this group hardly justifies any interpretation.

The Relation of Mastitis Infections to Age

Data on the age of the cows was collected systematically from 1950 onwards, and in the 4 years 1950–53, 1,781 samples were received which could be assigned to age groups. The distribution of all infections and the different types of infections according to age will be found in Table IV.

TABLE IV
THE INCIDENCE OF THE DIFFERENT MASTITIS INFECTIONS IN RELATION TO AGE, 1950–3

	Age groups in years										
	< 2	2—3	3—4	4—5	5—6	6—7	7—8	8—9	9—10	> 10	Total
Str. agalactiae	0	16	31	83	114	85	56	21	9	13	428
Str. dysgalactiae	1	25	26	46	44	34	16	9	6	1	208
Str. uberis	0	25	45	54	86	57	23	11	6	12	319
Staph. aureus	0	27	40	36	45	39	16	14	7	9	233
C. pyogenes	3	17	14	32	33	16	15	6	4	3	143
Other infections	0	28	45	47	39	40	22	7	6	7	241
Negative samples	0	12	15	16	24	14	4	5	2	0	92
Contaminated samples ...	Not analysed										
All infections	4	170	233	341	402	299	161	79	42	50	1,781

All Infections. The figures in each age group increased until the peak of 402 cases occurred in the 5 to 6 year group and thereafter they declined.

Str. agalactiae infections. There was a marked peak of incidence in the 5 to 6 year group, which provided 114 cases.

Str. dysgalactiae infections. With this organism the increase in incidence with age was less marked and the largest number (46) occurred in 4 to 5 year group, although the next group had 44 cases and there were 34 cases in 6 to 7 year group. This was followed by a decline. The effect was that of a plateau rather than a peak.

Str. uberis infections. The distribution of these infections resembled that of *Str. agalactiae* infections, the peak incidence of 86 cases was in the 5 to 6 year group.

Staph. aureus infections. Although the largest number of infections (45) was in the 5 to 6 year group appreciable numbers were in groups 3 to 4 years (40), 4 to 5 years (36) and 6 to 7 years (39), and in consequence the peak-like effect was not so marked.

C. pyogenes infections.—These infections occurred in almost equal frequency in age groups 4 to 5 years (32) and 5 to 6 (33) and in the younger and older groups the numbers relatively were enough to reduce the peak-like effect.

Other infections. There was a roughly equal incidence of infections in age groups 3 to 4 years (45) 4 to 5 years (47) 5 to 6 years (39) and 6 to 7 years (40) so that a plateau distribution occurring fairly early was the pattern with these heterogeneous infections.

It will be appreciated that in each succeeding age group there were fewer cows at risk and as a result relative distribution of infections within these groups would be distorted. In an attempt to correct this distortion the number of mastitis cases in each age group were expressed as a percentage of the estimated total number of cows in each age group in the practice in 1951.

The results are shown in Table V and Fig. 4.

This correction brings out more clearly the marked peak of incidence of all infections which occurred in the age group 5 to 6 years. In considering the different types of infection it will be seen that this peak at 5 to 6 years of age also operated quite distinctly with *Str. agalactiae* and *Str. uberis* infections, but to a less extent with *Staph. aureus* infections. The tendency to peak at 5 to 6 years of age was hardly discernible with *Str. dysgalactiae*, *C. pyogenes* and other infections (the latter are not depicted in Fig. 4).

The Relation of Mastitis Infections to the Stage of Lactation

The distribution of all mastitis infections and the different types of infection in relation to the stage of lactation are shown in Table VI and Fig. 5.

The majority of clinical attacks of all types of mastitis, 35·8 per cent., occurred in the early stage of lactation, *i.e.* the second to seventh week after parturition. The incidence of mastitis in relation to calving was about 13·5 per cent. and the long period of mid lactation (8th week to drying off) provided approximately 20 per cent. The distinction between drying off and dry periods is somewhat indefinite and because of this their figures can be amalgamated when it will be seen that they comprised over 30 per

TABLE V
THE INCIDENCE OF MASTITIS INFECTIONS IN RELATION TO AGE EXPRESSED AS PERCENTAGES OF THE ESTIMATED COWS AT RISK IN 1951

	Age group in years					
	2—3	3—4	4—5	5—6	6—7	Over 7
Estimated number of cows at risk ...	1,068	946	734	553	534	426
% All mastitis ...	3·4 (37)	8·3 (79)	11·7 (87)	22·7 (137)	17·0 (91)	11·7 (50)
% *Str. agalactiae* ...	0·4 (5)	1·3 (13)	2·5 (19)	6·3 (35)	3·3 (18)	3·0 (13)
% *Str. dysgalactiae*	0·4 (5)	0·6 (6)	1·7 (13)	2·3 (13)	1·8 (10)	1·1 (5)
% *Str. uberis* ...	0·2 (3)	1·3 (13)	1·6 (12)	6·6 (37)	4·3 (23)	2·8 (12)
% *Staph. aureus* ...	0·4 (5)	1·4 (14)	1·9 (14)	3·2 (18)	2·2 (12)	1·4 (6)
% *C. pyogenes* ...	0·6 (7)	0·6 (6)	1·3 (10)	2·1 (12)	0·7 (4)	1·1 (5)
% Other infections	0·2 (3)	1·4 (14)	1·5 (11)	2·3 (13)	2·8 (15)	1·1 (5)

(The figures in brackets are the actual numbers of infected animals)

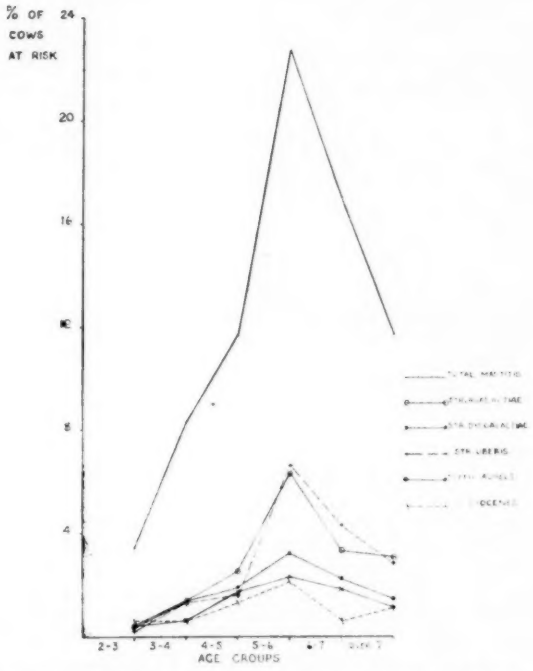

FIG. 4.—Corrected incidences of mastitis infections in age groups.

cent. of the total. From these results one must conclude that early lactation and the period of involution of the mammary gland were the most susceptible periods for infection.

With two exceptions the same pattern was true of the different types of mastitis. *Str. dysgalactiae* followed this pattern but showed an appreciable number of infections, 24 per cent. (54 cases) in dry cows. When the drying off period was included this became 34 per cent. of the total.

The distribution of *C. pyogenes* infections was different. It is obvious that these infections predominated in dry cows (62·4 per cent.) but an appreciable number occurred in cows at calving (17·0 per cent.).

The marked preponderance of *C. pyogenes* infections in dry cows and a tendency of *Str. dysgalactiae* infections also to be a feature of infections in dry cows is a reflection of a well recognised pattern in summer mastitis.

The Relation of Lactation and Infection to Season

The relation of stage of lactation to infection may also be connected with the time of year and so an attempt was made to assess the data in seasonal terms. Limitations of space preclude the detailed presentation of all the tables and figures for each type of infection, but those for all infections will be found in Table VII and Fig. 6.

The infections at calving occurred in the early part of the year, were few in number in early summer

TABLE VI
RELATION OF MASTITIS INFECTIONS TO STAGE OF LACTATION 1950–3

	Calving	Early	Mid	Drying off	Dry	Total
All infections ...	271 (13·5)	718 (35·8)	400 (19·9)	266 (13·2)	350 (17·4)	2,005
Str. agalactiae ...	57 (11·6)	184 (37·2)	115 (23·4)	91 (18·5)	44 (8·9)	491
Str. dysgalactiae ...	25 (10·8)	78 (33·7)	47 (20·3)	25 (10·8)	56 (24·2)	231
Str. uberis ...	56 (15·6)	125 (35·0)	70 (19·6)	52 (14·5)	54 (15·1)	357
Staph. aureus ...	43 (16·1)	97 (36·3)	59 (22·1)	40 (14·9)	28 (10·4)	267
C. pyogenes ...	28 (17·0)	22 (13·3)	8 (4·8)	4 (2·4)	103 (62·4)	165
Other infections ...	31 (11·3)	131 (48·0)	56 (20·5)	27 (9·8)	28 (10·2)	273

(The figures in brackets are percentages)

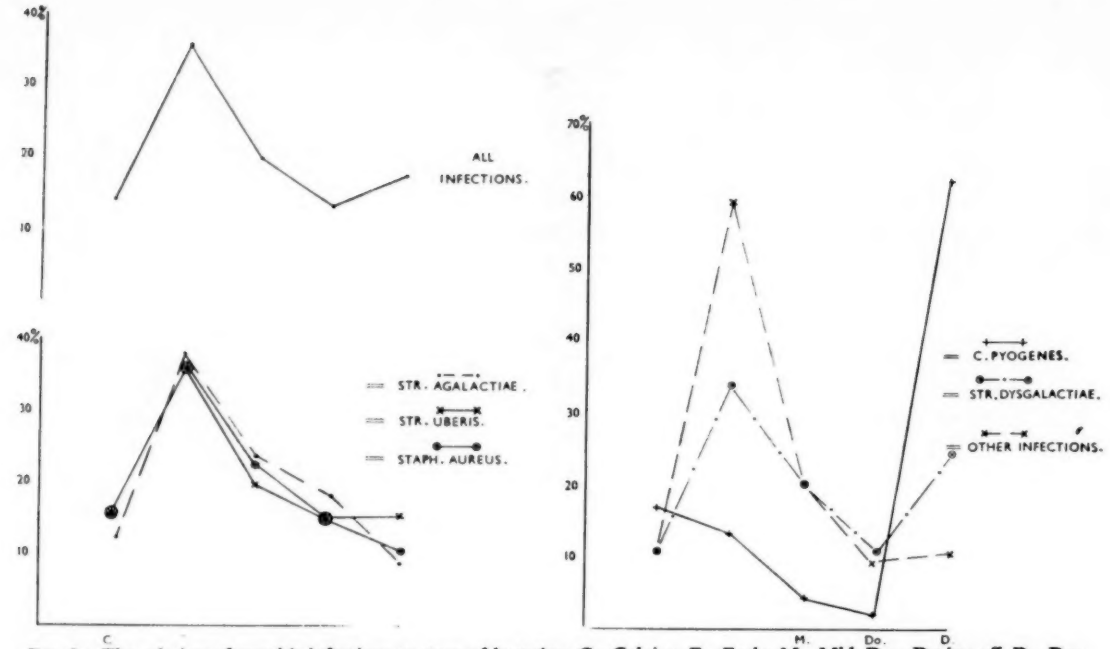

FIG. 5.—The relation of mastitis infections to stage of lactation. C—Calving, E—Early, M—Mid, Do—Drying off, D—Dry.

and started to increase again in late summer and the first part of the winter. Calving infections in the main were winter infections.

A similar distribution, to a much more exaggerated degree, was true of infections in early lactation.

The mid lactation infections occurred in greatest number at the beginning of the year and then exhibited a continuous decline to the end of the year. Infections in drying off animals showed a definite peak in mid summer to be accompanied and followed by marked peaks of dry cow infections in July, August and September.

Str. agalactiae infections followed the total infection patterns in calving cows, and in early and mid lactation. The infections in cows drying off were considerable in mid summer but the few infections in dry cows occurred mostly in the winter months.

Str. dysgalactiae infections did not conform to the overall distribution. Most of the calving cow infections were in the late summer and autumn, and the early lactation infections followed the total infection distribution. Mid lactation infections were somewhat irregularly distributed throughout the year, but drying off and dry cow infections showed marked peaks in the second half of the summer and autumn.

Str. uberis infections fitted the general pattern at calving, early and mid lactation, but the occurrence in drying off and dry cows was irregular and there were appreciable numbers of infections in dry cows in the winter.

Staph. aureus infections were distributed in a similar manner to *Str. uberis* infections, with rather fewer dry cow infections in winter and a small peak of infection of late summer infections in drying off cows.

C. pyogenes infections showed a characteristic

TABLE VII
RELATION OF ALL INFECTIONS IN STAGES OF LACTATION TO MONTHS IN THE YEAR, 1950–3

	Calving	Early	Mid	Drying off	Dry	Totals
January	36 (15·1)	100 (43·2)	54 (23·3)	16 (6·9)	25 (10·8)	231
February	18 (9·2)	74 (37·9)	64 (32·8)	11 (5·6)	28 (14·4)	195
March	27 (12·4)	85 (39·0)	75 (34·4)	12 (5·5)	19 (8·7)	218
April	22 (15·0)	51 (34·7)	47 (32·0)	21 (14·2)	6 (4·0)	147
May	6 (6·0)	31 (30·4)	35 (34·3)	26 (25·5)	4 (4·0)	102
June	7 (7·5)	27 (29·0)	32 (34·4)	23 (24·7)	4 (4·3)	93
July	10 (6·8)	21 (14·5)	22 (15·0)	54 (37·0)	39 (26·7)	146
August	15 (7·8)	33 (17·3)	17 (8·9)	44 (23·0)	82 (42·4)	191
September	27 (17·5)	38 (24·6)	10 (6·5)	18 (11·7)	61 (39·6)	154
October	35 (25·7)	52 (37·1)	15 (10·7)	15 (10·7)	23 (16·4)	140
November	35 (20·3)	89 (51·7)	8 (4·6)	15 (8·7)	25 (14·5)	172
December	33 (15·2)	117 (54·1)	21 (9·7)	11 (5·0)	34 (15·7)	216

The figures in brackets are the percentages of the total infections for the month.

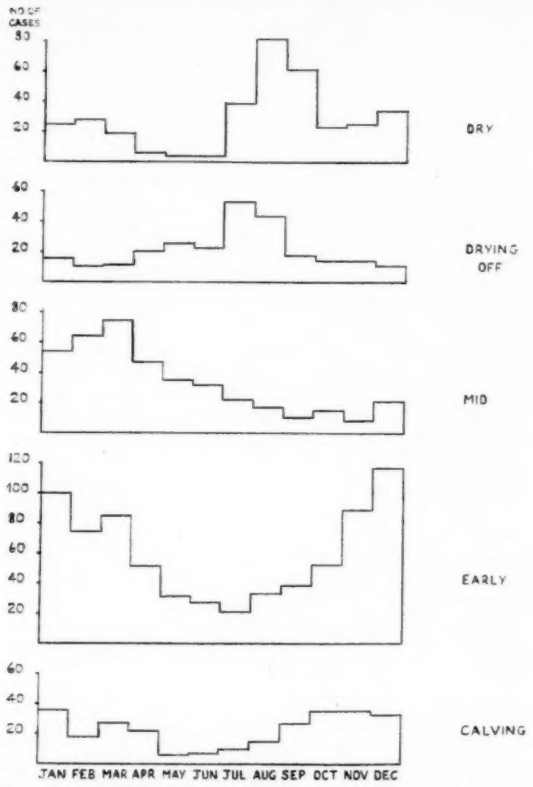

FIG. 6.—All infections in stages of lactation and time of year, 1950-53.

pattern unlike any other infection. As was to be expected there was an exaggerated peak of dry cow infections in July, August, September, and there were minor peaks in calving cows in the latter half of the year and in mid winter. The few cases in early lactation occurred in autumn and winter. The incidence in mid lactation and drying off cows was negligible and showed no seasonal pattern.

Other bacterial infections. Those followed the overall distribution, except for a very marked peak of infections in early lactation in December.

Bacteriologically negative samples. The majority of these were obtained from cows in early lactation, but infections in dry cows were also frequent. If drying off and dry stage infections are considered together they become the most important (39·1 per cent.).

Mixed Infections

Each sample has been allocated to a definite category of infection (see section on Methods) according to the preponderant organisms isolated, but some consideration must be given to those cases from which more than one bacterial species were recovered.

The relation of these mixed infections to each other are presented in Table VIII.

Certain features of these results are of interest. *Str. agalactiae* was the species least frequently accompanied by other bacteria ; only 15·5 per cent. of them were part of a mixed infection. At the other extreme *Staph. aureus* was mixed with other micro-organisms in just over 65 per cent. of the milk samples in which it was present. Thus *Staph. aureus* was the most frequent co-existent micro-organism with *Str. agalactiae* (8·7 per cent.) and *Str. uberis* (18·1 per cent.) and next to the most frequent with *Str. dygalactiae* (17·2 per cent.). In whatever way the figures are presented *Staph. aureus* appeared to be the most frequent organism present in a mixed mastitis infection.

There was also a definite association between *Str. dysgalactiae* and *C. pyogenes.* In the case of the former species, *C. pyogenes* was also present in 18·8 per cent. of the samples. An analysis of the *C. pyogenes* samples showed that 27·0 per cent. also contained *Str. dysgalactiae.* This association was more marked in certain years than others, particularly in 1949 and 1951. These 2 years were years of high summer mastitis incidence.

It must be remembered that the samples were cow samples, not quarter samples, and it does not necessarily follow that the mixed infections were in the same quarter of the udder. The above data must only be regarded as the co-existence of mixed mastitis infections in the same cow.

Discussion

Although the literature contains many reports on the incidence and the bacteriology of clinical bovine mastitis it would seem that the British post-war (1939-45) literature contains only 2 articles describing bacteriological surveys based on all the affected animals presented to the attending veterinary surgeons and excluding post-treatment samples. These articles are by Arthur (1947) and Francis and Berger (1951). Arthur's material was somewhat unusual, for it was obtained from herds under much closer veterinary supervision than is customary and under a high standard of management. Francis and Berger's results were derived from cases seen in the course of conventional veterinary practice and they can be regarded

TABLE VIII
MIXED MASTITIS INFECTIONS

	Mixed infections/ Total infections	*Str. agalactiae*	*Str. dysgalactiae*	*Str. uberis*	*Staph. aureus*	*C. pyogenes*	Other infections
Str. agalactiae	107/689 (15·5)	—	14 (2·0)	13 (1·8)	60 (8·7)	4 (0·5)	16 (2·0)
Str. dysgalactiae ...	141/302 (46·6)	14 (4·6)	—	4 (1·3)	52 (17·2)	57 (18·8)	14 (4·6)
Str. uberis	141/484 (29·1)	13 (2·6)	4 (0·8)	—	88 (18·1)	13 (2·6)	23 (4·7)
Staph. aureus	220/337 (65·2)	60 (17·8)	52 (15·3)	88 (26·1)	—	7 (2·0)	13 (3·8)
C. pyogenes	92/211 (43.6)	4 (1·9)	57 (27·0)	13 (6·1)	7 (3·1)	—	11 (5·2)
Other organisms... ...	77/360 (21·3)	16 (4·4)	14 (3·8)	23 (6·3)	13 (3·6)	11 (3·0)	—

as a true cross section of mastitis as it occurred in their area at the time.

Since that time widespread antibiotic treatment by farmers, either with or without their veterinary surgeons' approval, has resulted in a situation in which bacteriological surveys of all individual mastitis cases as they occur in the many herds of a veterinary practice have become almost impossible. It is probable that the survey now under discussion was one of the last that could have been taken on such a basis and even in this one its completeness was suspect towards its close (see below).

Overall Incidence

The results show that in this survey the total infections per year varied from 16·6 to 11·8 per cent. Over the years 1950–52 the incidence of mastitis was 13·9 per cent.

Dalling and Stableforth (1948) stated that of 1,749 cows in 48 herds sampled bacteriologically, 11 per cent. had obvious mastitis on the day of sampling. Withers (1955, 1957) has presented valuable figures on wastage and disease incidence, including mastitis, in dairy herds. His figures for mastitis incidence in Surrey, Berkshire and Wiltshire were as follows :

	1950–51	1951–52	1952–53	1953–54
Per cent.	8·1	7·1	10·1	14·5

More recently (Withers, 1959) further figures based on 6 widely separate areas showed that the overall incidence of mastitis, including summer mastitis, varied slightly from one area to another. In 1955–56 the incidences in Devon were 13·12 per cent., Shropshire, 12·34 per cent., Ayr-Lanark 10·81 per cent., and the Yorkshire West Riding 10·23 per cent. In 1956–57 six South Midland counties had an overall incidence of 9·09. Withers' figures were based on farmers' records and may well tend to be underestimates, but they do not suggest there has been any noticeable decline in the total incidence of bovine mastitis since my survey in South Derbyshire in 1949–53.

Nevertheless a consideration of my figures for total incidence showed a decline from 625 cases in 1949 to 519 in 1952 and 308 in 1953. The lower figures in the last 2 years, particularly in 1953, may have been due to an actual decrease in the number of cases of mastitis or to some change in the scope of the survey, or both. During the period of the survey penicillin as a treatment for mastitis became increasingly widely used. In the early stages veterinary surgeons restricted its use to their own hands, but as time went on they had to yield to their clients' requests for supplies of penicillin to be used by the farmers themselves. In the practice on which this survey depended there was no appreciable release of penicillin to farmers until 1952. Inevitably the cases the veterinary surgeons were called to see in 1953 were less representative of the overall mastitis problem than in previous years, although some of the farmers continued to submit samples prior to antibiotic treatment. Whether these figures reflected the beginning of a genuine decline is problematical.

While the overall incidence of mastitis may not have declined this survey showed preliminary evidence that the bacterial species were changing in their relative importance. *Str. agalactiae* infections were numerically the most important single species although they declined from 28·8 per cent. in 1949 to 20·4 per cent. in 1953. Even in 1953 they were the most numerous single cause of mastitis. *Staph. aureus* infections presented a feature of considerable interest. In the first 4 years its incidence fluctuated somewhat but in 1953 it rose to 16·3 per cent. One hesitates to quote figures from the results of 1954 when the basis of the survey had probably suffered further distortion, but it is of interest that of the 394 samples examined *Staph. aureus* was recovered from over 19 per cent., making it numerically the most important species. In the same year *Str. agalactiae* infections had further declined to just under 14 per cent. It was the experience of the attending veterinary surgeons that they were frequently unable to distinguish between the two infections on clinical symptoms, so in the years 1953 and 1954 it is improbable that selection of cases by the owners influenced the results. Subsequent evidence, admittedly collected on a different basis, points to the steadily diminishing importance of *Str. agalactiae* and the increasing frequency of *Staph. aureus* as a cause of mastitis. (Wilson, 1954, Animal Health Reports, 1955, 1956, 1957).

Str. uberis infections

Str. uberis is not an organism which has received much detailed attention by workers on mastitis, but its numerical importance in this survey placed it as the second most frequent cause of mastitis and its incidence remained steady throughout the period of study. In those British records in which it is listed separately, *Str. uberis* did not appear to be very important numerically ; Arthur (1947) and the Animal Health Reports (1957) gave figures of approximately 9 per cent., about half the incidence in this survey. In certain herds in this survey it was the prevailing infection.

Str. dysgalactiae infections

The contribution of *Str. dysgalactiae* to the overall incidence fluctuated from year to year and this was a partial reflection of its role in the summer mastitis complex, for in years of a high summer mastitis incidence *Str. dysgalactiae* was also higher. However, appreciable numbers of infections with this organism also occurred in lactating animals and over the period of the survey its incidence never fell below 9·0 per cent. There was no evidence of a definite trend upwards or downwards during the 5 years. Attention has been drawn to the association between *Str. dysgalactiae* infection and injury to the udder, by Ferguson (1944), Arthur (1947) and Berger and Francis (1951). Although information was not specifically sought on this point in this survey such an association was not a prominent feature of the clinical notes submitted with the samples. Thus in 1949 injury was mentioned in only 7 instances of the total of 65 infections with *Str. dysgalactiae*.

C. pyogenes infections

The incidence of *C. pyogenes* over the 5 years was 7·8 per cent. but such a figure may bear little relation to its importance in a year of high summer mastitis incidence, *e.g.* 11·75 per cent. in 1952. Arthur's results (Arthur, 1947) were outstanding for their high incidence of *C. pyogenes* (17·9 per cent.) and *Str. dysgalactiae* (15·4 per cent.) infections and it was clear that summer mastitis was a problem of some magnitude in his herds, but no year by year data were provided. Berger and Francis (1951) did not present yearly results although they stated that 1949 was a " moderately bad year " for summer mastitis in that the incidence was 1·8 per cent. of all cows (64 cows out of 3,500) and perhaps 4 per cent. of cows that were dry during the summer danger period. Pearson (1950) gave figures of 10·0 and 8·8 per cent. of non-lactating animals for 1948 and 1949 in Northern Ireland, and Weitz (1949) recorded incidences of 11·7 and 2·6 per cent. of dry cows in Anglesey in 1946 and 1947. In both these areas summer mastitis was regarded as a problem. Withers (1957) stated that summer mastitis probably did not exceed 0·5 per cent. of all cows in his recorded herds in Surrey, Berkshire and Wiltshire in the years 1950–53, but the summer of 1954 provided a serious outbreak of the disease with an incidence of 3·2 per cent. His more recent publication (Withers, 1959) also brings out the difference between years and areas.

It is appreciated that an expression of the incidence in terms of dry cow stock at risk in the second half of the summer is the most realistic basis for assessing incidence, but it was not possible to obtain such a basis in this survey. It is also recognised that some of the figures in the literature on summer mastitis refer to a complex of infections rather than *C. pyogenes per se*. The association between *C. pyogenes* and *Str. dysgalactiae* in this syndrome is evidence of this complexity which has been further defined on an experimental basis by Stuart, Buntain and Langridge (1951). These authors also showed that other organisms were probably involved in its causation.

Incidence of other infections

The results under this heading include too many bacterial species in few numbers to justify drawing conclusions from the figures. The literature contains many references to infections caused by a large variety of micro-organisms and the widespread use of antibiotics by farmers without adequate veterinary supervision may well result in increasing numbers of such infections in the future. American experience suggests this possibility (Schalm & Woods, 1953).

Bacteriologically Negative Samples

The incidence of bacteriologically negative samples was not high (5·2 per cent. for the 5 years) and there was a constant decline from 7·8 per cent. in 1949 to 3·2 per cent. in 1953. In some more recent surveys they constituted a numerically important category (Laing & Malcolm, 1956 ; Animal Health Reports, 1955, 1956, 1957). The latter probably included a considerable number of post-treatment samples, which were not a feature of this survey.

However, even in carefully conducted surveys a proportion of samples may be post-treatment if the farmer has used some chemotherapeutic or antibiotic first-aid prior to enlisting veterinary help.

Another possible cause for some of the negative results may be bactericidal properties of the inflammatory udder secretion which have destroyed the infecting bacteria. Films of such secretion sometimes reveal poorly staining, presumably dead, organisms within inflammatory cells.

Lastly the possibility must be seriously considered that mild inflammatory changes may take place in mammary tissue in the absence of any bacteria. This so-called non-specific mastitis has been given considerable attention by Laing and Malcolm (1956). As yet there is no evidence what may cause these inflammatory changes, and whether it is one condition or several.

Mixed Infections

It is clear that mixed infections were not uncommon although it must not be forgotten that the samples were cow and not quarter samples. Of the specific infections, *Str. agalactiae* was most likely to occur on its own, whereas staphylococci usually accompanied other organisms. The tendency to mixed infections, especially with *Staph. aureus*, is brought out in the Animal Health Report for 1957, and with the general decline in incidence of *Str. agalactiae* mastitis and the marked increase in staphylococcal mastitis one must expect the bacteriological background of clinical mastitis to be more complex to-day than it was in the past. This, coupled with a tendency to increasing resistance of mastitis staphylococci to penicillin may partially explain some of the difficulties of present day treatment.

The Seasonal Patterns

This survey has shown that, with some variation from year to year, there is an over-all pattern in the incidence of mastitis throughout the year. There is an increased incidence of mastitis in the winter months, the spring and early summer are characterised by a low incidence and the late summer and early autumn may provide high peaks of incidence in certain years but not in others.

At this point one should draw attention to the seasonal trends in dairy herd wastage and culling that have been recorded by Stewart and O'Connor (1957a, 1957b). Their data bring out the low incidence of disease in early summer and its tendency to increase through the latter part of the summer to higher levels in winter. Mastitis and summer mastitis were among the conditions which contributed to this seasonal disease pattern.

The British literature has not much to say on the seasonality of mastitis, apart from summer mastitis, but Arthur (1947) and Berger and Francis (1951) have provided some evidence. Arthur wrote that " although it is generally accepted that the health of dairy cows is at its lowest during February, March and April, there is no increase in the mastitis incidence at this time." This statement must be a comparison with his high summer figures of 21·9 per cent. in

August, for in fact his winter figures, except for December, are similar to those obtained in this survey.

Berger and Francis presented their results by quarters of the year and found an appreciable incidence in the two winter quarters, a low incidence in the second quarter and a marked increase in the third quarter.

It is tempting to speculate on the causes of the low incidence of mastitis in the spring and early summer. There is much information on the hormonal control of the mammary gland, and as long ago as 1941 Francis drew attention to the possible influence of hormonal disturbance on the development of bovine mastitis, but season may also have its effects on hormonal mechanisms. Some rapidly growing pastures in spring contain an increased content of oestrogens, and Schoop and Klette (1952) have shown that oestrogenic fractions of grass can cause sterility and mammary disturbance in cattle. This would seem to contradict the low incidence in spring and early summer but the effect of increased light on the activity of the anterior pituitary gland must also be remembered (Yeates, 1954).

These factors, and others, may play their part on the mammary gland's seasonal susceptibility or relative insusceptibility to infection.

As far as the individual infections in relation to season are concerned one can summarise the findings as follows : *Str. agalactiae* infections, staphylococcal infections and bacteriologically negative samples exhibited no particular seasonal distribution. *Str. uberis* infections were prevalent in the winter months and this finding is supported by Wilson (1954) and Berger and Francis (1951), although the latter group *Str. uberis* infections with those caused by staphylococci, unclassified streptococci, *Str. faecalis* and "sterile" mastitis. Some of these species would be included in my category of other bacterial infections which in the years 1950 and 1952 also exhibited a winter incidence. *C. pyogenes* infections showed their characteristic seasonal occurrence in the latter half of the summer and autumn. *Str. dysgalactiae* had a dual character according to whether it infected the lactating or dry udder. In the former it usually caused an acute mastitis in all seasons, but the typical suppurative process in the dry udder occurred in the summer mastitis season.

Although there is a seasonal pattern to total mastitis incidence and to certain infections one must remember that there is a relation between season and stages of lactation. The seasonal calving pattern in a herd will have an effect on the number of animals at risk to certain organisms.

The relationship of season and stage of lactation can only be effectively studied in herds in which the numbers of cows at each stage of lactation are known. Observations on these lines have been recorded by Oliver *et al.* (1956). These authors wrote "The evidence in this report shows the difficulty in freeing data of this kind from stage of lactation effects. However, it is probable that season of the year has a very minor effect on udder infection." While accepting their first proviso one cannot accept their conclusion in the light of one's own evidence or that of the literature. Nevertheless, seasonality may be a reflection of environmental conditions favourable to types of infection, *i.e.* winter housing and *Str. uberis* : certain species of flies (*Hydrotoea irritans*) and summer mastitis (Bahr, 1953 ; Animal Health Report, 1956 ; Withers, 1957).

The Relation of Mastitis Infections to Age.

There are many references in the literature to the relation between age of the cows and udder infection and mastitis. While the bulk of this evidence is impressive, many of the records make no allowance for the decreasing numbers of cows at risk in the older age groups. However, Murphy (1945 *et seq.*) has presented his views at length on the effect of age. His data showed an increasing susceptibility with age to *Str. agalactiae* infection which he maintained was a function of age *per se* rather than a reflection of the extended opportunities for infection. On the other hand he stated that staphylococcal infections did not follow this increasing with age pattern.

Ormsbee and Schalm (1949) and Schalm and Woods (1953) have opposed Murphy's views. Providing cows with incompetent teat sphincters were excluded, they found that susceptibility to *Str. agalactiae* was randomly distributed regardless of, and independent of, age and previous infection. In 1953 they modified their views to some extent as they found a direct correlation between advancement in lactation age and a high level of shedding of *M. pyogenes* (staphylococci).

The most satisfactory evidence on this problem of age and infection was provided by Lancaster and Stuart (1949) and Stuart and Lancaster (1949), working with experimental *Str. agalactiae* infections in cows. They clearly showed that ease of infection increased with age and that it was not a function of teat patency.

The increasing incidence of mastitis up to the age of 5 to 6 years found in this survey was also recorded by Berger and Francis (1951) after they had corrected their figures for the numbers of cows at risk.

In this survey the increase was more marked with some species than others. It was most marked with *Str. agalactiae* and *Str. uberis* infections, to a lesser extent it was also present with staphylococcal infections and it was relatively inconspicuous with *Str. dysgalactiae* and *C. pyogenes* infections. After the age of 6 years all infections declined, and this decline was not due to the fewer cows at risk. The reason for this decline has not been determined but it may be due to a reduction in the numbers of susceptible cows consequent on culling and wastage, either for mastitis or for other reasons which may also unknowingly have weeded out the mastitis prone animals. It is not possible to state whether the increasing incidence up to 5 to 6 years was due to age *per se* or increasing exposure to infection, but as far as *Str. agalactiae* is concerned the evidence of Stuart and Lancaster suggests that age in itself is the factor.

The Incidence of Mastitis in Relation to Stage of Lactation

Much of the considerable amount of information in the literature on mastitis in relation to lactation is difficult to correlate. The difficulty results from the varying aims and definitions of the investigators and their different methods in obtaining their data. Some authors limited their conclusions to "new" infections (Ineson & Cunningham, 1949; Neave *et al*, 1950), whereas others (Arthur, 1947; Berger & Francis, 1951, and Withers, 1951) based their results on mastitis cases as they arose, without considering whether they were "new" infections or not. The definitions of stages of lactation also varied.

Nevertheless, despite these difficulties their evidence points in the same direction as the results in this survey. These can be summarised as follows; the early stage of lactation (2nd to 7th week after calving) is the period of greatest susceptibility (35·8 per cent.) but this is almost equalled by the drying off and dry periods (30·6 per cent.).

However, certain species do not conform to this general pattern. As was to be expected, *C. pyogenes* in particular and to a less extent *Str. dysgalactiae* and "negative" samples were more prevalent in dry cows, whereas *Str. agalactiae* was a relatively uncommon infection of the non-lactating gland.

The early stage of lactation was important for all species except *C. pyogenes*, but all species produced mastitis in the calving animal. Mid lactation provided a number of infections with all species, except *C. pyogenes*, but their incidence was relatively low considering the long duration of this stage.

Some of the infections causing clinical disturbance after calving may have arisen during the dry period (Neave *et al*., 1950) and this may be related to the fall in the bactericidal and bacteriostatic titres of milk that have been demonstrated during the drying off period by McEwen and White (1950).

Conclusion

An understanding of the problems of bovine mastitis, while recognising the interplay of many factors in its aetiology, must be based on an adequate bacteriological knowledge of the infections with which it is associated. Such knowledge can only be acquired by bacteriological examination of sufficiently numerous samples of representative cases of mastitis. Furthermore, such sampling must be extended over a considerable period of time, for the seasonality of the different infections may give distorted pictures of the relative importance of some infections if the survey is limited to one part of the year. Ideally it should continue for a number of years, so as to include year by year fluctuations and to allow the demonstration of increases or decreases of particular infections. This type of survey is becoming increasingly difficult to arrange on a truly representative basis owing to the widespread treatment of the disease by farmers, who tend to call in veterinary help only for the more intractable cases.

Apart from the intrinsic importance of knowing the relative frequency of the different infections, surveys of this type also high-light epidemiological features of mastitis which need further investigation. It is clear that the predisposition of the mammary gland to infection at particular stages of lactation needs fundamental study. The increasing with age pattern of certain infections raises questions which may be a reflection of susceptibility or resistance of the cows. The marked tendency for organisms such as *C. pyogenes* to favour the non-lactating gland point the need for much more detailed work on the metabolic requirements and activities of this and other species of mastitis bacteria.

Finally the low incidence of mastitis in general in the spring and early summer, coinciding as it does with the improved health of cows at this time merely reminds us of how little we know of the factors which determine good health and how they operate under conditions of modern dairy husbandry.

Acknowledgments.—The survey would have been impossible without the co-operation and enthusiasm of Mr. E. Wilkinson, M.R.C.V.S., of Derby and his colleagues, and I am deeply in debt to them for their help.

The directors of Boots Pure Drug Co. Ltd., provided the necessary laboratory facilities and I am particularly indebted to the late Sir Jack Drummond, F.R.S., for his interest and encouragement. Mrs. Jane Buol gave continuing and careful technical assistance through the greater part of the survey.

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(*Concluded at foot of col.* 1 *overleaf*)

The Victoria Veterinary Benevolent Fund

A meeting of the Council of the Victoria Veterinary Benevolent Fund was held at No. 10, Red Lion Square, London, W.C.1, on Thursday, April 21st, 1960, when the following members were present :—

Mr. H. W. Dawes (President) in the chair, Mr. E. P. Barrett, Major J. J. Dunlop, Mr. E. Clark, Mrs. M. I. Field, Mr. R. C. U. Fisher, Mrs. D. I. Glover, Dr. R. E. Glover, Professors R. Lovell, J. McCunn, Mr. D. H. L. Madden, Miss V. Tillemont-Thomason and Major W. H. Wortley.

In attendance : Mr. R. V. Thatcher (Solicitor) and the Secretary, Mr. C. W. Francis.

Minutes

The Minutes of the previous meeting, held on January 28th, 1960, having been published in THE VETERINARY RECORD, were taken as read and signed as correct.

Apologies for Absence

Letters of apology for absence were received from Mr. G. Atkinson, Professors T. Bosworth, C. Formston, Messrs. G. N. Gould, J. M. Ingram, Professor A. Messervy, Capt. T. Mitchell, Professor L. P. Pugh, Mr. J. N. Ritchie, Major C. W. Townsend, Capt. W. Watt, Capt. A. Whicher, Messrs. H. M. Wilson, E. Wilkinson and Dr. W. R. Wooldridge.

Correspondence

The Secretary submitted :—

(*a*) A letter from the Veterinary Medical Association of Ireland, February 1st, 1960, enclosing cheque for the sum of £400, made up of £10 10s., life membership fee from Mr. M. Twomey, and the balance from various contributions.

It was resolved : That the Secretary be instructed to write to Mr. J. A. Flynn, Hon. Treasurer, expressing the Council's appreciation and warm thanks for the valuable financial help received from the Veterinary Medical Association of Ireland.

(*b*) A communication dated February 18th, 1960, from the Hon. Secretary, South Wales Division, stating that the President had been nominated to serve on the Council in the place of Mr. W. E. Hughes, who had resigned.

Accountant's Report

The Secretary read the following report, which was approved, a vote of thanks being accorded to the respective donors :—

Since the previous meeting the following special subscriptions and donations have been received :—

	£	s.	d.	£	s.	d.
Subscriptions						
Kenya Veterinary Association ...	2	2	0			
Veterinary Medical Association of Ireland	389	10	0			
Western Counties Veterinary Association	10	10	0			
				402	2	0
Donations						
Bruford, J. W.	20	0	0			
East Midlands Division Raffle ...	17	8	0			
Elstead Horse Show	2	2	0			
Hare, W. C. D.	2	10	0			
Highland Canine Association ...	2	2	0			
Lakeland Veterinary Association ...	10	0	0			
Lincolnshire and District Division Dance	66	4	6			
London Graduates—April, 1960 ...	2	10	0			
Kenya Veterinary Association ...	8	8	0			
McKay, W. M.		9	0			
North of Ireland Veterinary Association	30	0	0			
Society for the Study of Animal Breeding	15	0	0			
Twomey, M.	10	10	0			
Warwickshire Veterinary Club ...	5	0	0			
White, J. A.	5	0	0			
Yorkshire Veterinary Society ...	10	0	0			
„ „ „ Raffle...	8	5	6			
				215	9	0
Collecting Boxes						
Bushman, G. N.	12	0	0			
East Midlands Division	14	6	5			
Essex Veterinary Society	4	15	6			
North of Ireland Veterinary Association	27	9	4			
Western Counties Veterinary Association	14	1	2			
				72	12	5
				£690	3	5

Life Membership

It was resolved : That Mr. M. Twomey, M.R.C.V.S., be elected a Life Member of the Fund.

Freehold Land at Winkton

(*a*) *Report of the Wortley Axe Sub-Committee.* The President stated that since presenting its report to the Council on December 2nd, 1959, the Sub-committee had held two further meetings, *i.e.* on February 25th, and the second earlier to-day. At the former, consideration was given to a communication received from the Mary Elizabeth Dacombe Trustees which stated the price which had been fixed per freehold plot, including the provision of a new road and the essential services, etc. The Committee decided, however, that an independent valuation should be obtained before making a recommendation to Council.

Messrs. W. H. Willoughby & Sons, Chartered Surveyors, Bournemouth, were accordingly written to and their report and valuation, dated March 1st, 1960 (copies of which were circulated with the Council agenda) received careful consideration by the Sub-committee at its meeting held earlier in the day when it was decided to put forward a report including certain recommendations.

Some Epidemiological Patterns in Bovine Mastitis.—*Concluded.*

STUART, P., BUNTAIN, D., & LANGRIDGE, R. G. (1951). *Ibid.* **63.** 451.
———, & LANCASTER, J. E. (1949). *J. comp. Path. Therap.* **59.** 31.
WEITZ, B. (1949). *Vet. Rec.* **61.** 123.
WILSON, C. D. (1954). *Ibid.* **66.** 775.
WITHERS, F. W. (1955). *Ibid.* **67.** 605.
———. (1957). *Ibid.* **69.** 446.
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YEATES, N. T. M. (1954). In Hammond, J. "Progress in the Physiology of Farm Animals," Vol. I, Chap. 8, p. 372. Butterworth, London.

After prolonged discussion, *it was resolved :* That the Sub-committee's report be received and adopted.

(*b*) The Council then deliberated on whether the Fund itself should purchase 2 or more of the remaining 6 plots, and unanimously agreed, in view of the Wortley Axe Sub-committee's recommendation to purchase plots Nos. 7 and 8, that the Victoria Veterinary Benevolent Fund should acquire plots Nos. 5 and 6, and that the Secretary be directed to submit a proposed price for the said 4 plots. In the event of such offer being declined, the Executive Officers be given discretionary powers to continue negotiations within the limits indicated by the Council.

Draft Annual Report

The draft Annual Report for 1959 was submitted and with a few amendments approved for issue to Members prior to the Annual General Meeting.

Cases

No. 152, widow, aged 79. The Secretary reported that in view of the reply received from the National Assistance Board regarding the grant proposed in this case, the Executive Committee had contacted a local practitioner, who had kindly agreed to arrange for this widow to receive a regular supply of coal.

Resolved : That the action of the Executive Committee be approved.

No. 245, widow, aged 76. Only income that received from the Fund.

Resolved : That the present grant be continued for a further 12 months.

No. 264, daughter of late member, aged 70. Receiving allowance from National Assistance Board.

Resolved : That the present grant of £1 p.w. be continued for the ensuing year ; and that a member of Council's offer for his daughter to visit this case, be warmly accepted.

No. 275, widow, aged 55. In delicate health. Two sons, ages 26 and 23, latter partially paralysed. Receiving small Government pension. Children and sister contribute towards the home.

Resolved : That for the next 12 months the present grant of £2 p.w. be continued.

No. 285, widow, aged 86. Daughter, aged 45, an invalid, living with mother. Income : allowance from National Assistance Board, and a small amount from cottage rents.

Resolved : That the grant of 30s. p.w. be continued for 12 months.

No. 299, widow, aged 64. Income : N.I. pension and a little from lettings. Brother also helps occasionally.

Resolved : That the present grant be continued for the next 12 months.

No. 306, widow, aged 50. Three sons, ages 20, 17 and 13. The Secretary, having submitted a statement of her income for the past year, it was unanimously agreed that the present grant from the Fund be continued for a further 12 months.

No. 314. The Secretary reported the death of this recipient, which took place at the end of February last.

No. 332, widow, aged 60. Having regard to a report received on this case.

Resolved : That the grant for the next 12 months be increased to 30s. p.w. to take effect as from April 1st.

No. 334, widow, aged 70. The Secretary informed the meeting that the further report required on this case had not yet been received.

Resolved : That the present grant be continued and that the case be left in the hands of the Executive Committee.

No. 335, widow, aged 52, with 2 sons, aged 22 and 16 (at public school). In view of the report from a member of Council on her recent visit to this case, and the correspondence received by the Secretary from this applicant, it was decided that the present grant be continued until the next meeting.

No. 336, widow, aged 80, receiving help from the National Assistance Board. The Secretary reported that as she was in need of financial help to clear off arrears of local rates and other debts, the Executive Committee asked a local practitioner to visit this applicant. In view of her report the Committee decided to discharge the outstanding rates and to make a special grant of £10 in this case. The action of the Executive Committee was approved, and the Secretary was instructed to write to the Regional Officer of the National Assistance Board concerning this recipient.

No. 337, daughter of late member, aged 44. Earning £600 p.a. Has a child aged 4 years 9 months. Application for assistance towards child's education. In submitting this case to the meeting the Secretary intimated that this request had been before the Executive Committee who felt the application was one which ought to be dealt with by the Council.

Resolved : (*a*) That in the first instance the applicant should be interviewed and a member of Council's offer to visit this case and make a report was warmly accepted.

(*b*) That such report be referred to the Executive Committee, with power to act.

No. 338, widow, aged 52. In poor health. Four children : sons, ages 13 and 17, daughters, aged 20 and 21.

Resolved : (*a*) That, as this application has the support of the V.M.A. of Ireland's Scrutinising Committee, the Secretary be instructed to write to the Hon. Treasurer for the Committee's views concerning the amount to be given in this case.

(*b*) That this case be left in the hands of the Executive Committee.

Date of Next Meeting

It was agreed that the date of the next Council meeting, be left in the hands of the Executive Committee.

Other Matters

Telephone at Secretary's Residence. In view of the recommendation of the Executive Committee, it was agreed that steps be taken for the telephone to be provided at the Secretary's residence as soon as possible.

ADVISORY COMMITTEE ON ARTIFICIAL INSEMINATION

The Minister of Agriculture has reconstituted the Central Advisory Committee on Artificial Insemination for a further 3 years. The Pig Industry Development Authority is now represented on the Committee.

The Committee's terms of reference are to advise the Minister on general control and development of artificial-insemination of livestock (except poultry) in England and Wales. It will sit under the chairmanship of the Earl Waldegrave, Joint Parliamentary Secretary to the Ministry. The members are: Sir John Barlow, Bart., Sir John Hammond, Dr. H. G. Sanders, Mr. J. W. Salter Chalker, Mr. F. C. Golledge, Mr. H. Shilleto, Mr. E. C. J. Allday, Mr. I. H. Lamb, Mr. A. S. Cray (also represents the Pig Industry Development Authority), Mr. W. Bellerby, Mr. W. R. Trehane, Dr. Joseph Edwards, Mr. P. Sutcliffe, and Mr. L. E. A. Rowson, nominated by the British Veterinary Association. The secretary of the Committee is Mr. F. J. S. Culley of the Ministry.

News and Comment

VETERINARY SERVICES LISTED IN A.A. 'PHONE BOXES

Members are asked to check notices in the roadside telephone boxes of the Automobile Association to ensure that they provide the name, etc., of the nearest veterinary surgeon. In cases where the address of an animal welfare society is quoted, will members kindly ascertain whether a 24-hour-a-day service is available there. Should there be any omissions or factual errors in the telephone box notices the secretary of the B.V.A. should be informed.

THE BIRTHDAY HONOURS LIST

Among those honoured by Her Majesty in the current List were the following: Mr. Harry M. Wilson, M.R.C.V.S., of Cupar, Fife, for some years a member of the R.C.V.S. Council who has been awarded the O.B.E.; Mr. T. H. Jones, M.R.C.V.S., senior honorary veterinary officer to the Royal Welsh Agricultural Society, O.B.E.; Mr. K. D. S. MacOwan, B.SC., M.R.C.V.S., Director of Veterinary Services, Kenya, C.B.E.; and Mr. A. L. Mitchell, a well-known agricultural journalist, and a good friend of the B.V.A., M.B.E.

SUPPLEMENT TO THE BRITISH VETERINARY CODEX

We should like to draw the attention of our readers to the Supplement which brings up to date the invaluable British Veterinary Codex, published by the Pharmaceutical Press, under the direction of the Council of the Pharmaceutical Society of Great Britain. It will be remembered that a number of eminent members of the profession were invited to assist in the compilation of the Codex, and this addition to it is greatly to be welcomed. The price is 35s.

TROPHY FOR WORK ON PIGS

The publishers of *Pig Farming* have decided to make a special annual award, which will take the form of a silver challenge trophy, to the person who, each year, is judged to have made the greatest contribution to the pig industry in Great Britain and Northern Ireland.

The prize will be known as the "David Black Award," in memory of the late David Black, of Bacton, Suffolk, who devoted many years of his life to pig production and marketing in this country. The winner will be selected by a committee representing all sides of the pig industry, and pig farmers, as well as those engaged in research, and advisory and educational work, will be eligible to compete. The first presentation will be made in January, 1961.

PETER WILSON BEQUEST LECTURE

The latest of these lectures, in a series being delivered at the Royal (Dick) School, was given on June 1st. Professor Robertson introduced the speaker.

"To those who are at all familiar with the veterinary profession the name of Gordon Knight is practically synonymous with small-animal surgery; but such is the modest and self-effacing nature of our lecturer that few will be fully aware of the background to that well-deserved reputation.

"Mr. Knight qualified as a veterinary surgeon in London some 30 years ago and after 8 years in general practice he returned to his *Alma Mater* to take charge of the Beaumont Animal Hospital. There he remained throughout the whole of the war years keeping the hospital functioning under what, as you will realise, were exceptionally difficult conditions though, fortunately for us—and, of course, for Mr. Knight—the hospital escaped any direct hits. There he continues still, now in happier times, supervising the activities of the hospital, teaching the students and acting as counsellor and friend to the numerous veterinary surgeons who continually seek his advice. Yet in spite of all this he has found time to make many valuable contributions to veterinary knowledge in fields as varied as orthopaedics, thoracic and ophthalmic surgery, radiology and anaesthetics.

"His reputation as a surgeon has led him to be much in demand for lectures, demonstrations and the making of technical films not only in this country but in territories as far apart as Europe, America, South Africa and the West Indies. We can consider ourselves fortunate that he has accepted the invitation to contribute to our series of Peter Wilson Bequest lectures and I know you are all looking forward eagerly to his discourse on "Canine Intraocular Surgery."

THE JOINT MEASUREMENT SCHEME

As a result of a request by the British Show Hack and Cob Association, the show hack "Kavora Another Star" was remeasured by two referees appointed by the Royal College of Veterinary Surgeons, and found to be fifteen hands. This hack is therefore eligible to compete in hack classes not exceeding 15 hands.

UNIVERSITY NEWS

Cambridge

It is proposed to hold a Post-graduate Clinical Course from September 26th to 28th, 1960. Details can be obtained from the Administrative Secretary, School of Veterinary Medicine, Madingley Road, Cambridge.

London

The Royal Veterinary College Students' Union Society held their 168th annual ball on June 3rd at the Park Lane Hotel.

Sir Jocelyn Lucas, who is a member of the Board of Governors of the College, was the guest of honour. The many other guests included Mr. J. N. Ritchie, C.B., President of the Royal College of Veterinary Surgeons; Dr. R. E. Glover, Principal of the College; and Professor J. McCunn, Vice-Principal, as well as other members of the academic staff. Mr. J.

Bleby, President of the Students' Union Society, paid tribute to Mrs. K. E. Mitchell who is retiring as Registrar of the College. The many students present also gave a rousing reception to Mr. Squire Stevens, who has recently presented the Students' Union Society with a billiards table.

Sir Jocelyn Lucas judged the hunting horn competition and presented a cup to the winner, Mr. A. Spurrell. Sir Jocelyn himself also obliged when asked to give a demonstration of the art of blowing a hunting horn.

THE COLONIAL VETERINARY SERVICE

Mr. J. G. Ross, V.R.O., Federation of Nigeria, becomes Principal Veterinary Research Officer, Federation of Nigeria.

THE REGISTER OF VETERINARY SURGEONS

The undermentioned gentlemen were registered on the Commonwealth List of the Register of Veterinary Surgeons on the dates indicated:—

MAPLESDEN, Douglas Cecil, D.V.M. (ONTARIO), 4, Mutual Avenue, Guelph, Ontario, Canada, June 13th, 1960.

SANKEY, John Alfred, D.V.M. (ONTARIO), 190, Whitchurch Road, Shrewsbury, Salop, June 8th, 1960.

MR. R. J. CAMPBELL

A. C. U. writes:—

Mr. R. J. Campbell was one of 4 young men, including the local medical practitioner, who lost their lives in a tragic drowning accident off the Gairloch coast in Wester Ross on June 5th.

He came to Gairloch only a few months ago as a practitioner under the Highlands and Islands Veterinary Services Scheme. A most likeable man, upright in his dealings and cheerful in disposition, he soon established himself as a very popular member of the small community in which he set up his home. His services as a skilful practitioner were appreciated over a wide scattered area, comprising mostly crofting townships. The heartfelt sympathy of all members of the profession, who had the privilege of knowing him, is extended to the sorrowing relatives, especially to his wife and two children at the tender age of four and two.

Mr. R. H. Wilcox, V.O., attended the funeral as a deputy for Mr. D. S. Barbour, Advisory Officer to the Highlands and Islands Scheme.

MR. W. W. HENDERSON

Mr. R. S. Marshall writes:—

The death on May 27th at Lymington, Hampshire, of William Walker Henderson, C.B.E., severs one more link with the early pioneer days of the Colonial Veterinary Service. Qualifying at Edinburgh in 1908 Captain Henderson spent 4 years in practice at Haslemere before appointment to the East African Protectorate in 1913.

Being on the Special Reserve of Officers of the Royal Army Veterinary Corps from 1910 he served in the East African Veterinary Corps from 1914 to 1918, being twice mentioned in dispatches. From 1921 to 1923 inclusive he was in the service of the Peruvian Government, but rejoined the overseas service as a Veterinary Officer in Nigeria in 1924. He was promoted to the rank of Chief Veterinary Officer, Nigeria, in 1927, a post (later called Director of Veterinary Services) which he occupied with distinction until his retirement in December, 1945.

An attractive and entertaining personality, "Jock" Henderson, as he was affectionately known by his staff, built up an effective Department by his enthusiasm, energy and drive. His opening of the first rinderpest immunisation camp in West Africa on Plateau Province is of historical interest, and latterly he was mainly responsible for the economic development of the livestock industry of the country. All his old colleagues will wish to extend to his widow and two daughters their sense of shared loss.

R.C.V.S OBITUARY

We record with regret the deaths of the following members of the profession:—

CAMPBELL, Robin Johnston, of Gairloch. Graduated Edinburgh, 1953. Died June 5th, 1960, aged 32 years.

FERN, Edward Tunstall, Romney, Second Marine Avenue, Barton-on-Sea, Hants. Graduated July 17th, 1922, at the Royal (Dick) Veterinary College, Edinburgh. Died May 23rd, 1960.

HENDERSON, William Walker, C.B.E., D.V.S.M. (VICT.), Fairfield, Lymington, Hants. Captain late R.A.V.C. Graduated May 20th, 1908, at the Royal (Dick) Veterinary College, Edinburgh. Died May 27th, 1960, aged 73 years.

PERSONAL

Birth

KERRY.—On May 22nd, 1960, to Valerie, wife of John Branch Kerry, M.R.C.V.S., of 36, Longlands Park Crescent, Sidcup, Kent, twin boys of which one survived, Stephen John, a brother for Claire Suzanne.

B.V.A. COMMITTEE AND COUNCIL MEETINGS IN LONDON, JULY, 1960

Finance Sub-Committee to be arranged.

Wednesday, July 20th, at 7, Mansfield Street

10 a.m. Farm Livestock Committee.
11.30 a.m. Home Appointments Committee.
2.15 p.m. Veterinary State Medicine Committee.
4 p.m. Parliamentary and Public Relations Committee.

Thursday, July 21st, at 7, Mansfield Street

10.30 a.m. Small Animals Committee.
2.15 p.m. General Purposes and Finance Committee.

Friday, July 22nd

10.15 a.m. Council Meeting in the Great Hall of the Royal Veterinary College, Camden Town, N.W.1.

COMING EVENTS

June

23rd (Thurs.). Meeting of the Sussex Division of the B.S.A.V.A. at the Imperial Hotel, First Avenue, Hove, 8 p.m.

24th (Fri.). Meeting of the North Wales Division at Bryn Adda, Dolgellau, 2 p.m.

25th (Sat.). Meeting of the North West Region of the B.S.A.V.A. at the Conservative Club, Market Street, Wigan, 7.30 p.m.

27th (Mon.). Meeting of the East Yorkshire Clinical Club at the Talbot Hotel, Malton, 8 p.m.

29th (Wed.). Summer Meeting of the Scottish Metropolitan Division in the Green Hotel, Kinross, 2.45 p.m.

Summer Meeting of the Lakeland Veterinary Association at Grange-over-Sands, 2 p.m.

Annual General Meeting of the North of Scotland Division in the Northern Hotel, Aberdeen, 2.30 p.m.

30th (Thurs.). Meeting of the Essex Veterinary Society at the Saracen's Head Hotel, Chelmsford, 7.30 p.m.

July

6th (Wed.). Meeting of the Technical Development Committee of the B.V.A., at 7, Mansfield Street, 10.30 a.m.

Meeting of the Dumfries and Galloway Division in the Crown and Mitre Hotel, Carlisle.

Annual General Meeting of the Lincolnshire and District Division at the George Hotel, Grantham, 2.15 p.m.

13th (Wed.). Summer Meeting of the Lancashire Veterinary Association at the University of Liverpool Veterinary Field Station, "Leahurst," Neston, 2.30 p.m. Dinner at the Hotel Victoria, Heswall, 7 p.m.

August 28th to September 3rd. 78th Annual Congress of the British Veterinary Association in Glasgow.

ADDRESSES OF DISEASE INFECTED PREMISES

The list given below indicates, first the county in which are situated the premises on which disease has been confirmed, followed by the postal address and date of outbreak.

Anthrax

Kirkcudbright. Back Newton, Twynholm, Castle Douglas (June 7).

Lancs. Bolton Peel Farm, Bolton by Bowland, Clitheroe (June 13).

Fowl Pest

Hunts. The Orchard, Rear of Norfolk House, Earning Street, Godmanchester (June 10); 8, Council Houses, Hemingford Grey, St. Ives; Apple Lane, Orchard, Hemingford, St. Ives (June 12).

Leics. Holwell Village, Melton Mowbray; 77, High Street, Syston (June 7); 45, Woodgate Road, East Leake, Loughborough; Forest Road Allotments, Loughborough (June 8); Manor Farm, Rearsby (June 9).

Lincs. Dailton, Wragby Road, East (June 12).

Norfolk. Bridge Farm, South Burlingham, Norwich (June 10); Larners Drift, Toftwood, E. Dereham (June 13).

Warwicks. Higham Lane, Nuneaton; Kinglawton, Ullesthorpe, Rugby (June 10).

Worcs. Piggotts Farm, Heightington, Bewdley (June 11).

Swine Fever

Anglesey. Trefor Newydd, Pentraeth (June 7).

Berks. Sanatorium Allotments, Eton Wick Road, Eton, Windsor (June 13).

Cambs. Grove Farm, Lower Carter Street, Fordham, Ely (June 13).

Ches. Moore Farm, Shocklack, Malpas; Oak Farm, Mannings Lane, Hoole Village, Chester; Owler Hall Farm, Tattenhall (June 8); Grange Farm, Mollington, Backford, Chester (June 13).

Cornwall. Goonearl, Scorrier, Redruth (June 7).

Devon. Clyst View, Old Rydon Lane, Topsham, Exeter (June 13).

Dorset. Peartree Cottage, Elmhurst Road, West Moors, Wimborne (June 7); Old Farm, West Bourton, Gillingham (June 13).

Flints. 127, Cefndy Road, Rhyl (June 10).

Hereford. Hope Springs, Mordiford; Eaton Hill, Leominster (June 7); Upper Hamnish, Kimbolton, Leominster (June 10); Butterfly Cottage, Roxpole, Stoke Lacey, Bromyard; South Bank, Much Marcle, Ledbury (June 13).

Herts. Chaldeans Farm, Much Hadham (June 8).

Isle of Wight. Ningwood Manor Farm, Ningwood, Yarmouth (June 13).

Lancs. Piggery, Chapel Field, Sandfield Road, Gateacre, Liverpool, 13 (June 7); Home Farm, Back Lane, Aughton, Ormskirk (June 10); 2, Linner Cottages, Halebank, Ditton, Widnes (June 13).

Leics. Pingle Farm, Enderby (June 7).

Lincs. Pecks Farm, Pecks Corner, Wrangle, Boston (June 7).

Norfolk. Painswhin Farm, Helhoughton, Fakenham (June 7); Mayflower Garage, Hingham, Norwich (June 9); Orchard Farm, Tibenham, Norwich (June 10).

Northants. March Road, Turves, Whittlesey, Peterborough (June 7).

Notts. 8, Main Street, Sutton-on-Trent, Newark (June 13).

Salop. Foldgate Piggeries, Ludford, Ludlow (June 9); Peaton Hall, Craven Arms; Greenfields, Ash, Whitchurch (June 10); Heath Farm, Clungunford, Craven Arms; The Elms, Ollerton, Market Drayton (June 13).

Somerset. Straps Orchard, Wincanton (June 9); Court Farm, Hillfarrance, Taunton (June 10); Mill Farm, Hillfarrance (June 13).

Staffs. Hill Top, Brewood (June 9).

Suffolk. Old Hall Farm, Ditchingham, Bungay (June 10).

Sussex. Oaklands Park Farm, Hurstpierpoint, Hassocks (June 9).

Wilts. Search Farm, Stourton, Warminster (June 9); Manor Farm, Teffont, Salisbury (June 10).

Yorks. Wood End Farm, Barkston Ash, Tadcaster (June 7); Pipering Lane Allotments, Bentley, Doncaster (June 8); Westfield, Main Street, Tunstall Roos, Hull (June 9); Sandwath Farm, Church Fenton, Tadcaster (June 13).

B.V.A. CAR BADGES

It is regretted that owing to a hitch in production, supplies of the B.V.A. car badge are not expected to be available until the middle of July.

DELIVERY OF "THE VETERINARY RECORD"

The Editor is very much indebted to many readers who have written to him on this matter. Strong representations have been made to the central postal authorities, and it is hoped the service provided will be improved shortly.

Letters to the Editor

The views expressed in letters addressed to the Editor represent the personal opinions of the writer only and their publication does not imply endorsement by the B.V.A.

GENERAL

Vaccination of Cattle with S.19

Sir,—Mr. Kirkwood's letter of June 4th draws attention to the articles on brucellosis (*Vet. Rec.* **72.** 419) and the comments he makes on my paper call for further clarification.

Firstly, he takes exception to my choice of the term "indiscriminate vaccination" as implying a criticism of the methods adopted by veterinary surgeons in applying S.19 vaccine. Perhaps the term may be interpreted in more than one way but I can assure him that criticism of the practitioner was not intended. Until the duration of immunity following calfhood vaccination with S.19 had been established, the vaccination policy throughout the country had to be indiscriminate in the sense that revaccination every 2 or 3 years was practised on the basis that it was better to be safe than sorry. Indeed this was the recommendation made to practitioners who sought advice. Now it is known that over 95 per cent. of calves vaccinated when 6, 7 or 8 months of age will pass the agglutination test for brucellosis at their first pregnancy. It has also been established that immunity at the fifth pregnancy following calfhood vaccination is not significantly lower than it was at the first pregnancy. Thus, revaccination is superfluous and it complicates the picture by making animals react to the agglutination test for long periods. In view of this, vaccination of self-contained herds can now be done with greater discrimination in the sense that it can be confined to calfhood vaccination and then, if there is a need to detect a cow that it excreting a virulent field strain in her milk, the agglutination test provides the first clue to finding the culprit. If, however, revaccination is practised it is much more difficult to find the animal. In flying herds, where the status of the animals at the time of vaccination is less perfectly known, vaccination has still to be done indiscriminately.

Secondly, Mr. Kirkwood's statement that "the onus of advising a client falls on the practitioner and him alone" may well be true, but judging by the number of practitioners who seek laboratory advice when faced with a problem herd, I get the impression that many prefer to place the onus on the advice they receive. For example, when a vaccinated herd with no clinical abortion is suspected of supplying infected milk it presents a problem that requires laboratory examination to determine if, in fact, infection is present, followed by detection of the animal or animals responsible for shedding infection.

Thirdly, I was not clear from Mr. Kirkwood's remarks about *Brucella abortus* in milk whether he was referring to the vaccine strain or a fully virulent field strain. The public health danger is not new, we have always been aware of it and in our early experiments, 17 years ago, it was clearly shown that the use of S.19 vaccine greatly diminished the amount of infection in the milk of a vaccinated group of cows compared with a similar control group when both were exposed to the same challenge with a virulent infection. Indeed, it was these experiments that persuaded the Ministry of health to agree to the use of S.19 vaccine on a nation-wide scale. With rare exceptions, infected cows shed organisms in the milk but it is becoming increasingly obvious that in some vaccinated herds which appear clinically normal, one or more animals may be producing infected milk due to a localised infection of the udder with a virulent field strain. When Strain 19 and Strain 45/20 were passaged in series for several generations through pregnant cattle it was found that S.19 retained its character of reduced virulence whereas 45/20 became fully virulent. Thus, S.19 appears to be a stable strain and under normal circumstances, is not excreted in the milk, whereas 45/20 and probably also the old "field strains" used for vaccine, are liable to revert to full virulence and to be excreted in the milk.

Lastly, I would like to say that the co-operation of many practitioners and others has been most helpful in enabling me to survey the incidence of infection in Oxfordshire and the Isle of Wight. Such surveys provide information that helps to assess the extent of the problem that would have to be faced if, at a later date, eradication of brucellosis is undertaken. Meantime, I hope practitioners will persuade their clients to have all their heifer calves between the ages of 6 and 8 months vaccinated, and as far as possible I hope they will refrain from revaccinating these animals. By adopting this policy they will help to simplify the problems that may arise if eradication is undertaken, and in fact they may well hasten the day when it becomes a possibility.

Yours faithfully,
A. McDIARMID.

Downe House,
Compton,
Nr. Newbury,
Berks.
June 13th, 1960.

Sir,—One notes with interest the letter from Mr. A. K. Kirkwood regarding indiscriminate vaccination with S.19 vaccine.

Reading and Compton are in close proximity geographically so that Mr. Kirkwood with his appreciation of the "learned doctor's" contribution to our knowledge of the problem of brucellosis was, and is, in a position to obtain the most up-to-date knowledge.

Mr. Kirkwood's letter does focus attention on what will be a serious problem if an attempt is

made to eradicate brucellosis in Great Britain and for that reason I am grateful. We in Northern Ireland for the past 3 years have been working on a scheme of eradication of brucellosis from which we have acquired considerable experience of clinically infected but abortion-free herds, of *Brucella* udder infection, and the presence of aberrant strains. That experience has shown that adult and late calfhood vaccination is a diagnostic menace if eradication is contemplated; it not only complicates the diagnostic tests but leads to the persistent blood titre cow which cannot be separated from field infection and which is our principal headache.

Mr. Kirkwood's letter shows that he appreciates this point and one is certain that all who have read his letter will consider the symposium on brucellosis published in THE VETERINARY RECORD to have been worth while. If it puts a stop to adult vaccination, indiscriminate or otherwise, call it what you will, a further advance will have been made towards the goal of ultimate eradication.

Yours faithfully,
W. R. KERR.

Ministry of Agriculture for Northern Ireland,
Veterinary Research Division,
The Farm,
Stormont,
Belfast.
June 7th, 1960.

Inoculation Against Distemper

Sir,—I have read with interest and some sympathy the letters of Mr. Carr and Mr. Trigger on the subject of inoculation against distemper. I hope I may be permitted as a "commercial" veterinary surgeon to reply.

It should first be emphasised that before offering a guarantee such as that under discussion, the marketing company must be supremely confident of the quality of the products to be guaranteed. It would be nothing less than foolhardy to undertake such a scheme with products which were not of the greatest excellence. Also, in offering this guarantee, the company is expressing its confidence that the veterinary profession will see that these vaccines are not used in the wrong way.

Mr. Carr states that competition between manufacturers in the canine vaccine field has become exaggerated to a point where it is undignified. I would emphasise here that the policy of the company in question as far as biologicals are concerned has been strictly ethical, all its biological products having been sold only through the veterinary surgeon. This policy has been maintained in spite of enormous difficulties, and even losses due to the massive advertising of similar products to the farmer, and their direct sale through retail chemists and farmers' co-operatives.

Advertising to the lay public under these circumstances is a necessity and not a willing choice. It would obviously be to the advantage of the company in question not to have to compete in this way, but where heavy advertising is carried out, the choice is to compete or to perish.

In selling biologicals the story is constantly reiterated by the prospective veterinary surgeon customer that he will "supply your products if the public ask for them." How else can the public be stimulated to ask for products other than those heavily advertised except by competitive advertising?

Yours faithfully,
T. STEWART.

Bayer Products Ltd.,
Neville House,
Eden Street,
Kingston upon Thames,
Surrey.
June 13th, 1960.

Sir,—In reply to Mr. Carr's letter, I would point out to him that anyone who vaccinates a puppy which has been on a public highway or any other public place where dogs have been, or even one from a litter where the dam has been in such a place, runs the risk of discrediting the vaccine he or she is using. I would also like to ask whether one has the right to refuse to vaccinate an apparently healthy puppy, whether it be in a pet shop, kennel or private house, if the owner is prepared to pay, after the risks attached have been explained to him or her?

With regard to the various advertising schemes at present employed to popularise one vaccine or another, I think we should bear in mind that, not only do they advertise the vaccine concerned, but also they advertise the profession, and this is something that has never been done before. We are given this advertisement free, or at the worst for the trouble of stocking one or two lines of the vaccines concerned.

If we do not like the advertisement of the profession in this manner, then it is time the profession did something to let the public know more about itself and what services it renders.

As a start, why not a national distemper eradication campaign? Impossible, I can hear people saying. Why? We have more than one company to draw on for vaccine, and with combined efforts the supply of vaccine should not prove an obstacle. Bulk production by the firms concerned, and the need to advertise against one another removed, a new low price should be possible. Suppose we devoted, on a national basis, say a few hours once a week or fortnight—or even monthly would be better than nothing—to a vaccinating session to which anyone could bring his or her dog and have it vaccinated for a minimal fee. The animals of old age pensioners and the blind could be treated free. I do not suggest it would be easy or foolproof, but a national scheme under the B.V.A., run by the Divisions, would achieve a great deal. After all, if it were rabies or some other disease with a public health aspect, we should have to do something about it.

Such a scheme would bring us plenty of ethical publicity, and would attract many thousands of people to our surgeries who might otherwise never come.

When one looks back, what has the profession as a whole, *unaided by the State*, done to rid our

animal population of such a disease as distemper? By this I do not mean to deny what has been done in the past, but merely to indicate that it has in general been done by dedicated individuals or research teams and not initiated by the profession and carried through by them on a national scale.

I ask you, would it not be a good thing in the future, if the profession, in the form of the B.V.A. *led* the demand for future eradication schemes rather than let the State or the National Farmers' Union have the loudest voice in the matter, and we, perhaps, be fortunate if we are allowed to help run it?

Yours faithfully,
H. D. CORYN.

Thoby Priory Lodge,
Thoby Lane,
Mountnessing,
Essex.
June 11th, 1960.

Sir,—The following is an open letter to the developers, manufacturers and distributors of canine vaccines.

Gentlemen,—It is possible that you have read at least some of the letters published in THE VETERINARY RECORD this year touching on your products, but I can find evidence that in only one case could you bring yourselves to reply.

Please accept this letter as a challenge from a mentally benumbed small-animal clinician who has almost reached the end of his tether; just a minor victim of a minor soap or margarine war. Will you please refrain from internecine strife for a few moments, listen to a few words of reason, and perhaps answer some questions?

As you may recall, the first egg-adapted distemper virus vaccine was introduced in 1953 with a blaze of publicity as a step forward in the prophylactic and therapeutic treatment of distemper, and of a mysterious disease, "hard pad," which had been the subject of hot debate since 1947.

There were discreet advertisements in the personal columns of the papers read by "top people," and not so discreet advertisements in the papers and magazines read by "doggy" people. This resulted in an overstimulation of demand which could not be met, and allowed foreign vaccines to enter the market.

Since then, things have gone from bad to worse. We now have the unedifying spectacle of representatives of one company denigrating the products of another, and of advertising which has descended to detergent and breakfast cereal level. Free insurance was offered by newspapers as a spur to increased circulation in the early thirties; now one company has reached this stage in sales promotion. Let us hope that no company gets really up to date, with the possibility of free toys, vouchers to householders allowing something off the cost of vaccination, or even a complete set of nickel-plated surgical instruments "as used in a well-known veterinary school," offered at the bargain price of 5 guineas plus the tops of 20 vaccine boxes.

By all means let us have advertising aimed at the dog owner. But let it be of the "Beer is Best," "Eat more Fruit" type, so that our clients do not come with preconceived ideas on the relative merits of canine vaccines—ideas formed entirely as a result of skilled advertising.

May I now ask some questions of those of you who are veterinary surgeons, virologists or scientists of any sort.

What is the duration of immunity produced by the various vaccines now on the market?

What booster injections are necessary?

What is the optimum age for inoculation?

What are the facts concerning the possibility of a virus interference effect when using a distemper/hepatitis combined vaccine with live viruses?

What are the relative merits of egg-adapted distemper virus vaccines, taking account of the fact that all bar one are from the same source?

What are the relative merits of hepatitis vaccines, *i.e.* between live vaccines of dog or ferret origin, or killed vaccines?

What are the potencies of your vaccines as sold, and why are these not stated on the containers?

What are the "shelf lives" of these vaccines?

Does live hepatitis vaccine of canine origin cause carriers and increase the spread of disease, and if so is live virus of ferret origin any better?

What is the incidence of unwanted sequelae to vaccination, *e.g.* "blue eye" following hepatitis vaccination with live virus?

What is the incidence of breakdown following vaccination?

We have a right to know the answers to these questions, and too often our enquiries are brushed aside.

In future I, for one, will buy vaccines from any company which does not make rash claims, and which does not advertise direct to my clients, until such time as I have adequate proof that better vaccines are available.

Yours faithfully,
H. E. CARTER.

36, St. George's Road,
Enfield,
Middlesex.
June 12th, 1960.

Bad Advice on Television

Sir,—The TV show for children seen yesterday evening, "Let's Go Riding," advocated that prospective purchases should be taken to the Club's riding master. I believe that this programme had the blessing of the National Pony Club.

I recall that a horse sold recently as being suitable for a girl proved to be "blind" in the right eye, and, therefore, reluctant to make a "right-turn" on the road. Such a horse would be a great danger to other road users, and a death trap to any inexperienced rider.

Yours faithfully,
IVOR HUGHES.

Honeysuckle Cottage,
Coleshill,
Warwickshire.
June 10th, 1960.

XUM

SCIENTIFIC

Serum Calcium and Magnesium Levels in Sheep Infected with *Fasciola hepatica*

Sir,—During the autumn and winter of 1958-9 many farmers in Wales experienced severe outbreaks of fascioliasis in their flocks. The treatment of the sick sheep was often unsatisfactory in spite of the provision of shelter and food, and the intramuscular administration of carbon tetrachloride. Estimations of the serum calcium and magnesium in a few infected sheep showed the levels to be rather low, particularly in the case of magnesium, and the subcutaneous administration of mixtures of calcium borogluconate and magnesium sulphate appeared to have some therapeutic value. These observations led to an investigation of the serum mineral levels in sheep experimentally infected with *F. hepatica*.

Ten crossbred Kerry lambs were reared under infection-free conditions in concrete pens, and fed a ration comprising concentrates and hay *ad lib*. Two lambs were kept as controls and the remaining 8 divided into 2 groups of 4. When the lambs were about 10 months old, group A were dosed orally with 600 cercariae of *F. hepatica* and group B were given 4 doses each of 150 cercariae at weekly intervals. Samples of blood and faeces were obtained at regular intervals from each lamb.

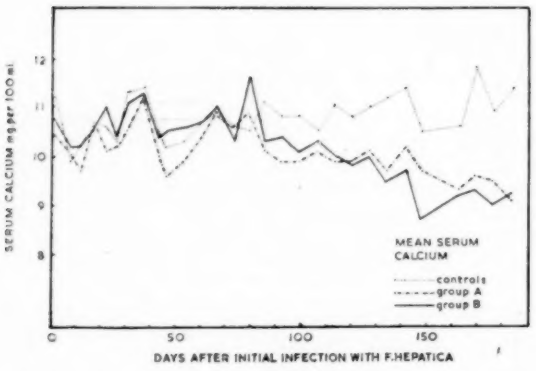

FIG. 1.—The mean serum calcium levels in groups of sheep following the oral administration of 600 cercariae of *Fasciola hepatica* either in a single dose (Group A), or in 4 equal doses at weekly intervals (Group B).

Fig. 1 shows the mean serum calcium levels of the controls and the infected groups. The trend is similar in both groups of infected lambs and shows a steady decline beginning about 80 days after the initial dose of cercariae. On the 183rd day of the experiment there was a difference of about 2 mg. per cent. between the controls and the infected lambs. Fluke eggs, indicating the presence of mature parasites in the bile ducts, appeared in the faeces at about the same time that the decline in the serum calcium began.

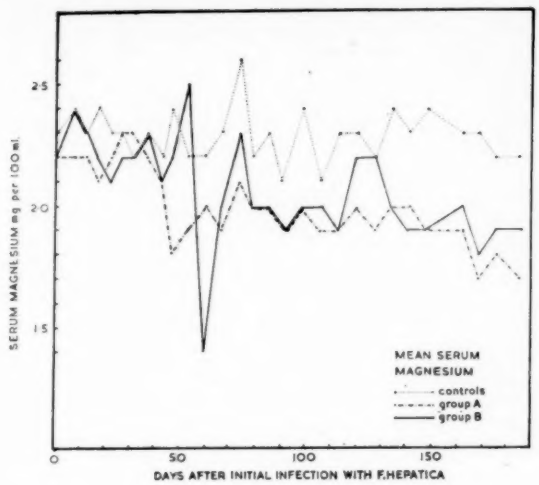

FIG. 2.—The mean serum magnesium levels in groups of sheep following the oral administration of 600 cercariae of *Fasciola hepatica* either in a single dose (Group A), or in 4 equal doses at weekly intervals (Group B).

Fig. 2 shows the mean serum magnesium level of the controls and the infected groups. In this instance, although the trend in both the infected groups is similar and shows fluctuations at a level below that of the controls, there is some difference between the groups during the earlier stages of the experiment. The mean serum magnesium level of the lambs in group A, which were given a single dose of cercariae, fell steeply between the 36th and 46th day of infection. On the other hand, the magnesium level of the group B lambs, which were each given 4 doses of cercariae at weekly intervals, fluctuated widely between the 43rd and the 79th day after initial infection, and a rise occurred between the 113th and the 134th day. A period of about 40 days is required for the migrating immature flukes to reach the bile ducts and the arrival of successive populations of parasites may have been the cause of the more pronounced changes in the magnesium level of group B lambs.

The depression of serum calcium in the infected lambs was not great enough to render symptoms of hypocalcaemia likely. But the serum magnesium in 4 infected lambs fell to 1.3 mg. per cent. or less, a level at which signs of tetany might occur, although they were not seen in this experiment. These results suggest that infection with *F. hepatica* might be a contributing factor in the occurrence of hypomagnesaemia in sheep. Equally, it may be that low serum magnesium is at least partly responsible for the clinical picture of fascioliasis.

Yours faithfully,

K. B. SINCLAIR.

Department of Animal Husbandry,
University College of Wales,
Aberystwyth.

May 24th, 1960.